CUK - HQ6650-136-RP266

University College of Science
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92 Upper Circular Rd Calcutta

Nature

A WEEKLY

JOURNAL OF SCIENCE

VOLUME ~~CXXXVI~~ 136

JULY, ~~1935~~ to DECEMBER, ~~1935~~
1935

"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

~~1935~~

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

RP R266

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Printed in Great Britain by
FISHER, KNIGHT & CO., LTD., The Gainsborough Press St Albans

NATURE
A WEEKLY JOURNAL OF SCIENCE

No. 3427 SATURDAY, JULY 6, 1935 Vol. 136

Pasteurization of Milk

THE heat-treatment, or 'pasteurization', of milk before consumption has in the past been the subject of controversy, but as a result of much research and inquiry during the last few years, this measure has come to be generally accepted as the best solution of the several problems presented by the use of raw untreated milk, particularly that of the transmission of infections. Detailed criticism of the application of the pasteurizing process to the general milk supply was, however, formulated by Sir Arnold Wilson in his recent presidential address to the Central Council of Milk Recording Societies of England and Wales last March, and some of the points he raises merit consideration.

It is suggested that the "principal, if not the only, reason" why pasteurization is practised is that it makes it possible to transport large quantities of milk from great distances, and to market it several days after production, in competition with fresh milk. Whatever may have been done in the past, we believe that to-day such a statement is inaccurate. Some 90–95 per cent of London's milk is pasteurized, and the large bulk of this is conveyed in the raw state and treated after arrival, and we question whether anywhere now 'large quantities' of milk are pasteurized for purpose of transport.

Compulsory pasteurization, which has been advocated in some quarters, is viewed with grave concern as being likely to upset present economic conditions, with the deprivation of a number of farmers of their means of livelihood. The Report of the Committee on Cattle Diseases is quoted in support, and the important qualifying paragraphs (Nos. 155–160) are criticised; the reactions that might be caused by such a measure are not considered to be solved by the suggestions made. Dr. Norman Wright, director of the Hannah Dairy Research Institute, surveyed this subject in 1931, however, and concluded that the effect of compulsory pasteurization, were it introduced (and this would probably be only in the larger urban areas), would be to eliminate the casual producer-retailer from large cities, to the advantage of the general body of milk producers, the established producer-retailer eventually becoming the chief purveyor of high-grade raw milk from tuberculin-tested herds. Moreover, this seems to be the experience in New York State, where compulsory pasteurization is general, though the growth of tuberculosis-free herds in Great Britain, where State assistance is lacking, to reach the American standard of freedom from tuberculous infection, would be lamentably slow under present conditions. In this respect, more State assistance is an urgent need in Great Britain.

It has been proved beyond doubt that the infections transmissible by milk—tuberculosis, typhoid fever, scarlatina, diphtheria, undulant fever and others—are destroyed by efficient pasteurization. The risk of tuberculous infection (occasionally other infections also) has, unfortunately, been increased of late by the introduction of the hygienic system of conveyance of milk in bulk, 3,000 gallons or so, in glass-lined road- and rail-tanks, for, should any portion of the milk in such a tank be infected, the whole will become infected. In the case of tuberculosis, in particular, this risk is a real one, for the bulk-milk is necessarily the mixed milk of a number of cows, some of which under present conditions will almost inevitably be infected with tuberculosis. Whereas, before the present system of bulk transport, only at most some 8–10 per cent of samples of milk tested contained the tubercle bacillus, Minett and Pullinger and Pullinger, respectively, found that of 43 and 63 samples of rail-tank bulk supplies examined, every one contained living tubercle bacilli. Undulant fever (*Brucella*) infection was also frequent. It is noteworthy that all these samples, examined after efficient commercial pasteurization, were entirely free from living tubercle bacilli and *Brucella*, certainly a tribute to the value of the process. Sir Arthur Newsholme says in his recent book "Fifty Years in Public Health": "It is for this reason [pasteurization] that milk outbreaks of acute infectious diseases are much rarer now than in the past".

Some 1,500 deaths annually in Great Britain may reasonably be ascribed to bovine tuberculous infection, and it is admitted that human beings may contract tuberculosis from milk and milk products. Sir Arnold Wilson appears to argue that because the mortality from tuberculosis transmitted by milk is so insignificant compared with the mortalities from other forms of tuberculosis and from other diseases, it may be ignored—"We cannot avoid all dangers: we should aim at excluding the greatest, and the bovine [tubercle] bacillus is shown to be among the least". But this view does not take into account the increased risk of infection with the bovine tubercle bacillus introduced by the present system of bulk transport.

The possible damage that may be done to the nutrient qualities of milk by pasteurization requires consideration. It is alleged that the vitamin, calcium and phosphorus contents are diminished, and the general nutrient qualities are lessened. It may be admitted that, in the case of infants subsisting on complete diets of cow's milk, pasteurized milk does seem to be deficient and to require supplementing as regards vitamins and salts, but there is no body of evidence conclusive of the relative merits of raw and pasteurized milk, and the subject demands further investigation. For children the bulk of whose nutritive requirements is satisfied from sources other than milk, Stirling and Blackwood state that there are no good grounds for the belief that pasteurized milk is a less valuable component of the diet than raw milk (*Bull.* 5, Hannah Dairy Research Institute), and Prof. J. C. Drummond, in a series of animal experiments, failed to detect any evidence that pasteurization adversely affects the nutritive value of milk.

Milk pasteurization, if carried out, ought to be efficient and free from any possible source of failure. The recognised system consists in heating the milk to a temperature of not less than 145° F., and not more than 150° F., and maintaining at this temperature for 30 minutes, after which it is cooled. It is obvious that to hold a large volume of milk, it may be up to 500–1,000 gallons in the large plants, within two or three degrees of a particular temperature for half an hour, entails the use of an apparatus the thermal control of which must be one of delicacy and exactitude. If any portion of the whole bulk of the milk is maintained at less than the proper temperature for the requisite time, disease germs may escape destruction; if the temperature rises above the limit, the 'cream line' may be damaged, and an excessive proportion of the lactic organisms, which bring about souring and curdling, be destroyed, so that the milk does not sour normally on keeping, but undergoes undesirable changes that are not apparent to the consumer. It should be emphasised, however, that the modern commercial pasteurizer has reached a high state of perfection, and provided that the plant is properly laid out in the first instance, it can easily do what is required without risk of failure. The statement has been made that pasteurized milk is more liable in the home to become infected than raw milk, presumably because of the destruction of the inhibiting lactic organisms, but the widespread system now in use of retailing pasteurized milk in bottles or other containers must minimise any such problematical risk.

There can be no doubt that at the present time pasteurization is often carried out inefficiently. The Cattle Diseases Committee was so impressed

by the evidence given before it of the importance of securing efficiency for this process that it recommends in its report that pasteurization of milk should be permitted only in plants the design of which has been officially approved, that have been tested on erection to ensure that they conform to the approved design, and are frequently inspected and tested during working by an officer of the sanitary authority. This officer would need to possess knowledge of the practical working of pasteurization plants and of their construction, if he is to carry out his duties of inspection, testing and supervision properly. The information required by officers of local authorities for this purpose has in the past been largely lacking, but is now provided in a report by Sir Weldon Dalrymple-Champneys, just issued by the Ministry of Health ("The Supervision of Milk Pasteurising Plants." *Reps. Pub. Health and Med. Subjects,* No. 77. London: H.M. Stationery Office, 1935. 1*s.* 3*d.* net). In this, the construction of premises and general 'lay-out' of a plant are first described, and then the constituent parts and mode of working are detailed. Considerable space is devoted to the important subject of thermal control, temperature recorders and thermographs, with diagrams and description of these. The subject of bottle cleansing is also considered, and finally—most important for the supervising officer—a tabulated description is given of the principles of, and points to be noted in, the inspection of a pasteurizing plant.

The fear expressed in the past by many medical officers of health and others that pasteurization, by increasing the keeping qualities of milk, would lead to less cleanly production, has not been borne out in practice, and it is probably correct to say that the present standard of hygienic milk production is higher than it ever was.

Viewing the subject as a whole and in its wider aspects, under present conditions the efficient pasteurization of milk appears to have much to commend it, and the advantages to the community outweigh the reputed disadvantages.

Sir Arthur Newsholme is of the opinion that so far from discarding or limiting the pasteurization of our milk supplies, the process should be extended, for he says: "The time is ripe for compulsory supervised and standardised pasteurisation of all milk supplies. This would reduce to a minimum the distribution of disease germs by milk, including especially the distribution of milk containing tubercle bacilli of bovine origin".

African Music

The Musical Instruments of the Native Races of South Africa

By Prof. Percival R. Kirby. Pp. xix+285+73 plates. (London: Oxford University Press, 1934.) 35*s.* net.

THE present volume will be welcomed by all concerned with native music, but particularly by anthropologists, for the twofold interest its subject presents. Musical instruments, on one side, have always been a favourite object for ethnological studies, because as products of handicraft they are part of a people's material culture, and by magic and religious functions they play at the same time a prominent rôle in tribal life. The most ancient culture forms, on the other side, are found surviving among those primitive races who have been compelled to retire into the remotest and least accessible regions, for example, the Fuegians, the Tasmanians, the Andaman Islanders, the Vedda in Ceylon, or the Bushmen in the Kalahari. It is true that in South Africa this isolation even of the most primitive tribes, namely, Bushmen, Hottentots and Bergdama, has since long been far from complete, extensive tribal migrations, or smaller movements, particularly of Bantu negroes, having from time immemorial chequered the map of racial and cultural distribution. This very distribution, however, is the safest, if not the only, basis for a reconstruction of the early history of the country, that is, the history before the arrival of the European explorers.

Prof. Kirby, known as a distinguished specialist from his earlier contributions to scientific periodicals, has attempted to collect, and to present in this book, as comprehensive a material as possibly can be collected in our days. Living in Johannesburg, he had the opportunity during nine great and many smaller excursions into native territory, not only to watch the native musicians, to obtain first-hand information and to collect several hundreds of their instruments, but also to learn to play them himself, which, of

course, is the best way to a complete understanding. Besides, he was assisted in his inquiries by quite an army of able helpers; and for supplementary information he has consulted the literary sources from Fr. João dos Santos (1586) onwards, and compared the instruments which he collected with the specimens in South African and European museums.

Thus, the author has succeeded in compiling an almost complete inventory of musical instruments found south of the Cunene-Limpopo line, comprising under the term 'musical instruments'—as the ethnologist is bound to do—any device for sound-production. The instruments are minutely described, and profusely illustrated by excellent photographs. The technique of playing is explained with the help of musical examples (partly transcribed from phonographic records). A description of the social function of every type, of its ritual, magic or other meanings, and of the occasions of its use, is included, and the distribution among the tribes of South Africa as well as the history so far back as it is possible to go on the evidence of early writers and native tradition, is traced for every instrument.

The only thing likely to be regretted by ethnologists is the lack of physical measurements of the tuning of such instruments as xylophones or reed pipe series; for coincidences in absolute pitch (expressed in vibration numbers) have proved the safest guide in tracing back the instruments to their very origin. Thus the African xylophones, at least the types with calabash resonators, are related to their prototypes in south-eastern Asia and Indonesia not only by their similar shape, playing technique and the characteristic musical scales to which they are tuned, but even by very identity of pitch[1].

Out of the almost inexhaustible wealth of detailed information we owe to Prof. Kirby's work, only a few examples may be selected, which most strikingly show its value for comparative ethnology. The Venda in northern Transvaal have a large bowl-shaped wooden kettle-drum with pegged-on diaphragm (which in itself is an Asiatic way of fastening); when they use it, for example, in their initiation ceremonies, the drum is suspended on the horizontal pole of a frame by means of ropes tied to two of the four drum handles, which are fitted in an ornamental band carved round the drum. Now, the suspension, the style of this carved wave ornament and the four-legged 'handles', which are called 'frog's knee' by the Venda—all these details closely resemble the so-called 'bronze drums' of China and Tonkin, on the plate of which invariably four plastic frogs are placed on the outermost circle of relief ornaments, marking the cardinal points. (In fact, the eastern Asiatic 'bronze drums' are more or less hour-glass shaped and have, apart from the frogs, also 'ears' fixed on the side. For both these traits there are parallels in the drums of the Barotse and other tribes in the southern Congo basin.)

Drums of this kind are also played in pairs, by a man and a woman respectively, in connexion with the reed pipe dances which form an integral part of that most important sacrificial rite which the Venda perform for their royal ancestors in the sacred groves where they are buried. This rite is at the same time a fertility cult to secure the new crops. A similar ritual at harvest time is performed for the spirits of departed women-chiefs, who haunt a certain bamboo bush at a sacred place, guarded by special taboos. From this particular type of bamboo, that is, from the 'female' rods which are hollow (whereas the 'male' rods are solid) the pipe-sets are cut, and tuned by an old man to whom this function is entrusted, the pipe ensembles and dances being a royal prerogative. The leader of the orchestra keeps the instruments, together with the drums and other sacred implements, in the council hut, and is responsible for them to the chief.

We may feel doubtful as to whether a series of stopped pipes distributed among different players—which apart from South Africa is found in Central and East Africa, Lithuania and Upper Burma—should be regarded as a precursory form or as a variant of panpipes. But there is no doubt that in their social function, as exemplified by the Venda customs, there is a striking resemblance to a tradition from the classical land of ancestor worshippers, China. It refers to the very beginnings of Chinese civilisation. Hoang Ti, one of the five mythical emperors, ordered, as tradition has it, his minister Ling Lun (that is, 'master of music') to institute the right foundations of music. Ling Lun went to a certain place far in the west, where the appropriate kind of bamboo grew, and cut the male and the female series of pipes, tuning them to the pitches of the tones which he heard sung by a couple of phœnix birds. The standard-pitch pipes, which by their length represent the basis for the Chinese system of measurement as well, were kept until recently in the Ministry of Measures and Music under the superintendence of one of the Imperial princes. The ancient Chinese pitches still survive on modern panpipes, for example, in Oceania and South America, and on xylophones, for which they must have been adopted originally from the panpipes. For the Venda the real standards seem to be not the pipe-sets, but rather, as Prof. Kirby suspects, a very old set of xylophone slabs. It was, in fact, a Venda xylophone by which the reviewer was first led to

the discovery of the identity of African and Asiatic pitches.

Certain queer types of South African instruments are the product of contact with the various forms of foreign influence. The old Hindu bar-zither, which was played rested on the left shoulder, with its resonator up and the peg down, is popular with many South African tribes. Here it is still held in the old way, but the original gourd-resonator has more recently been exchanged for a paraffin tin, and instead of plucking the string one uses a miniature friction-bow. The instrument is thus made to resemble an Arabic fiddle from the Sudan, held upside down. Or we find a vertical flute, with two or three finger-holes near the lower, stopped end, and a globular fruit shell for a mouth-piece on the upper end, which is played by Karanga and Venda boys. It looks as if a clarinet of the 'pibcorn' type (spread from Java over Southern Asia and Southern Europe finally to England) had lost its reed, thus rendering useless the mouth-piece which had served as a wind-chamber. A mixture between a North African clarinet and a globular flute occurs in North-West Africa. The most curious fact, however, is that the Karanga performer, when playing this flute, sings at the same time a short tune. Even this practice has its counterpart in some other part of the world, namely, among the Maori of New Zealand, who used to 'speak' on their flutes[2], and possibly among the Australians, who do not blow their trumpets, but use them merely as megaphones.

E. VON HORNBOSTEL.

[1] Cf. *Z. Ethnol.*, **43**, 601; 1911.
[2] Cf. J. C Andersen, "Maori Music", New Plymouth, New Zealand, 1934, p. 278.

Tropical Plant Diseases

(1) The Diseases and Curing of Cacao

By Prof. H. R. Briton-Jones. Pp. x+161. (London: Macmillan and Co., Ltd., 1934.) 10*s*. net.

(2) Diseases of the Banana and of the Manila Hemp Plant

By Dr. C. W. Wardlaw. Pp. xii+615. (London: Macmillan and Co., Ltd., 1935.) 30*s*. net.

THERE are several reasons for welcoming the first two of the manuals on the diseases of the major crops of the British Colonies, the need for a series of which was so strongly voiced at the Imperial Mycological Conference in 1929. They are from the West Indies, among the oldest of the Colonies and the most tried by the ravages of plant diseases. They have been written by members of the professorial and research staff of the Imperial College of Tropical Agriculture in Trinidad, where most scientific officers of colonial agricultural departments now complete their training, and are a testimony to the activity of that centre. They reflect the modern approach to phytopathology as concerned with safeguarding the health of the crop in its widest aspects, of which parasitic attack is but one. They are attractively written and produced, well illustrated, and with full and up-to-date bibliographies. In each case the important crop covered (Trinidad has 200,000 acres under cacao, and bananas are the mainstay of the export trade of Jamaica) is suffering from an epidemic disease which is causing much alarm.

(1) Prof. Briton-Jones's book on cacao diseases is written to interest, and be readily understood by, the educated planter. The diseases are clearly described, their cause indicated with as few technicalities as may be, and their control fully discussed. A chapter is given to the formidable witches' broom disease caused by *Marasmius perniciosus*, which reached Trinidad in 1928, though long known on the mainland of South America and doubtless indigenous in some part of that natural home of the cacaos. The disease in Trinidad is following the slow course which gradually extinguished cacao-growing in Surinam, and is not of the virulent type which caused a crisis in Ecuador in a few years after it first appeared there in 1921, probably coming from the Amazon basin, where it has recently been discovered to be widespread. It is in this area that the search for varieties that may be immune from infection is most likely to be fruitful. Breeding for resistance, however tedious, may be the only satisfactory means of control, though Prof. Briton-Jones indicates measures directed to increase the crop yield sufficiently to render the costly control by hand-picking the diseased parts profitable.

A useful section of this book, with a separate bibliography, is given to the preparation and curing of cacao.

(2) Dr. Wardlaw's book on the diseases of the banana, *Musa sapientum*, and the botanically allied Manila hemp plant, *M. textilis*, is planned on a more generous scale than the other. More is known of banana than of cacao diseases, and there are more of them; the useful list of fungi and bacteria recorded on the banana which Dr. Wardlaw has compiled

includes more than fifty parasites, not counting several virus diseases destructive in Australasia and the Far East and beginning to appear in the New World. The discussion of each disease is exceptionally full, well documented, and often enriched by the author's personal studies; scientific details are not spared, and the book will appeal as much to the professional plant pathologist as to the planter. A valuable section deals with the wastage of the fruit in transport and storage, based largely on the author's work at the Trinidad Low Temperature Station.

In this book also one disease, the wilt or 'Panama disease' caused by strains of *Fusarium oxysporum*, receives extended treatment on account of its outstanding economic importance. Unlike cacao witches' broom, it occurs in most parts of the world where its host plant is grown, but it is only in the West Indies and Central America that it has proved a scourge; there is little doubt that this is due to the almost exclusive cultivation for export in this area of the highly susceptible but unrivalled shipping variety, the Gros Michel. The wilt is decimating the Gros Michel plantations of Jamaica, and has caused the abandonment of many thousands of acres of rich banana lands in Central America. But, unlike cacao witches' broom, practical immunity from wilt is possessed by several more or less well-known edible and wild bananas, and breeding for disease resistance combined with shipping qualities is already well advanced both in Jamaica and at the Imperial College in Trinidad. One may question some of the author's views regarding the parasitism of the wilt-inducing fungus, without in any way belittling his achievement in the preparation of this manual.

Both of these works should have a place in the libraries of colonial agricultural departments and of their plant pathologists. E. J. BUTLER.

Galileo and the Leaning Tower of Pisa

Aristotle, Galileo and the Tower of Pisa

By Prof. Lane Cooper. Pp. 102. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1935.) 7*s*. net.

IT is generally believed that Galileo, as a young lecturer on mathematics and physics at the University of Pisa, gradually became convinced of the untrustworthiness of many of the statements which were currently believed and taught on the authority of Aristotle. Indeed, he has been stated to have incurred a certain amount of unpopularity on account of the subversive nature of his views. Among other things he doubted the truth of the oft-repeated statement that when two dissimilar weights are dropped, the heavier will reach the ground sooner than the lighter in proportion to their weights; accordingly, so we have been assured, Galileo determined to try the case, and after ascending the Leaning Tower of Pisa with a 10 lb. shot and a 1 lb. shot, he let them fall. "Together they fell, and together they struck the ground," to the confusion of all the onlookers who held the so-called Aristotelian view.

This story has been retold with variations by many historians of science, and the historic occasion has been marked as a turning point between the ages of the older traditional, and of the newer or experimental philosophies.

Prof. Lane Cooper, of Cornell, being desirous of studying the evidence for this Leaning Tower experiment, and finding that there is no book to which a student with limited access to foreign or ancient books can refer, has now made a critical study of the literature and has reprinted many relevant quotations, with English translations where necessary. In the whole collection he has satisfied himself that no one passage can be accepted as proof that Galileo, in 1590–91, or before he left Pisa for Padua in 1592, did ascend the Tower and do his historic experiments either alone, or in the presence of "the whole body of students" of the University.

There is no need to cite here any of the modern versions of the story, but it is curious that Prof. Cooper should not have mentioned the excellent life of Galileo by J. Elliot Drinkwater in 1829. The relevant points are these. Galileo died in 1642, never having once alluded in any of his own writings to the Leaning Tower or to experimenting from it. His biographer, Viviani, writing in 1654, states that he proved that moving bodies of the same material but of unequal weight all moved at the same speed by repeated trials (*con replicate esperienze*) from the height of the Campanile of Pisa, "in the presence of the other teachers and the whole assembly of students". As a result "his rivals, stirred with envy, were aroused against him".

Prof. Cooper points out that if this be a true presentation of the case, it is extraordinary that

there should be no reference in contemporary literature to so important an occasion.

A "Comparison of Aristotle and Plato" was published by Mazzoni in 1597 in which Galileo's principles of motion are accepted, but although the writer is in opposition to Aristotle, he does not allude to any researches of Galileo at Pisa. Again, when Coresio in his "Operetta intorno al Galleggiare de Corpi Solidi" (1612) entered into controversy against Mazzoni, he would certainly have referred to such experiments had they been made publicly at Pisa. Further, Renieri, Galileo's own successor in the chair of mathematics at Pisa, did indeed make experiments from the Tower in 1641 and wrote to Galileo about them, but there is no suggestion in their correspondence that similar experiments had ever been made there fifty years earlier, nor did Galileo allude to his having done anything of the same nature.

What is known of Galileo's work is derived from: (1) his manuscript "De Motu", written about 1590, consulted by Viviani in 1654, but not published before 1883; (2) his "Discorsi Matematiche intorno à due Nuove Scienze", published in 1638, in which two imaginary characters, Simplicio and Salviati, discuss in dialogue the laws of motion, evidently as contained in the "De Motu". In all this there is nothing about Pisa or about experiments during Galileo's sojourn there.

On the other hand, a number of men of science much earlier in the sixteenth century had already attacked the view then attributed to Aristotle, that bodies fall with a speed proportional to their weight. Among these were Giovanni Battista Benedetti, in his "Demonstratio proportionum motuum localium contra Aristotelem et omnes Philosophos", Venice, 1554, who was followed by Jean Taisnier "Opusculum", 1562; Cardan "de Proportionibus", 1570; Beato of Pisa, Ghini of Bologna and others, and especially by Stevinus of Bruges. Their previously printed works would have deprived any Leaning Tower experiment of 1590 of the originality that was claimed by Viviani sixty years after the supposed great day of Galileo.

In conclusion, Prof. Cooper rightly accuses Galileo of causing his 'Salviati' to affect to quote from Aristotle words that are not found in Aristotle's writings; and it is possible that in this has lain the cause of all the trouble.

So far the author's case appears strong. It is when he comes to deal with Aristotle's supposed views that his arguments incline to the irrelevant. He admits that Aristotle must, if pressed, have said that bodies would fall at different rates, so that his disquisition on the meaning of πίπτειν and 'falling' is immaterial.

Aristotle would have naturally used the word ῥοπή because he considered velocity as a quality inherent in the body itself, instead of something relative. What is really interesting is the long tradition of opposition to Aristotle that goes back far beyond Galileo, indeed even to the days of Philopon, as shown by his commentary on Aristotle's "Physica", written about A.D. 533.

Although we consider that Prof. Lane Cooper might have marshalled his material rather better, we are grateful to him for directing our attention to so important a field of historical study.

R. T. GUNTHER.

Thorpe's Dictionary of Applied Chemistry. Supplement

By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Vol. 2: *N—Z*. Pp. xx+727. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 60*s*. net.

THE second supplementary volume of Thorpe's "Dictionary of Applied Chemistry" departs from the original plan only in that it was not found possible to include an index, which will be published with a glossary in a third volume. Some of the articles are supplementary to those which appeared in the main series of volumes, for example, those on naphthalene by Prof. W. P. Wynne and Miss Turner, on proteins and their degradation products by Dr. W. V. Thorpe, on radioactivity and radium by Dr. A. S. Russell, on spectroscopy by Dr. R. A. Morton, on terpenes by Prof. J. L. Simonsen and on vitamins by Dr. L. J. Harris. On the industrial side, there is a very fully-documented article by Prof. J. R. Partington on the utilisation of atmospheric nitrogen, a long and well-illustrated article on petroleum by Dr. A. E. Dunstan, in addition to supplementary articles on sodium and potassium by Dr. R. N. Kerr, and on paint and varnish by Dr. R. S. Morrell.

New articles are those on the parachor by Prof. S. Sugden, on free radicals and on rhenium by Dr. T. G. Pearson, on the stereo-chemistry of cyclic compounds by Dr. W. H. Mills, on tautomerism by Dr. J. W. Baker, and on heavy water by Prof. H. V. A. Briscoe. On the industrial side, Dr. C. H. Lander contributes a new article on oil and petrol from coal. A curious limitation in the scope of the work is indicated by the fact that, whilst supplementary articles are provided on photography, photosynthesis and polarimetry (mainly in reference to new types of molecules exhibiting optical rotatory power), the general subject of photochemistry is not even indexed either in the original or in the supplementary volumes.

Since only the glossary and index are now outstanding, it may be said that the revision of the "Dictionary" has brought together a large amount of information that is not readily available in other publications, and that its value and usefulness are fully maintained by the new supplementary volumes.

Proceedings of the Fourth International Congress for Applied Mechanics, Cambridge, England, July 3rd-9th, 1934

Pp. xviii+283. (Cambridge: Printed at the University Press, 1935.)

THIS beautifully produced and illustrated book contains full reports of six general lectures together with short abstracts of more than a hundred sectional papers arranged alphabetically. The abstracts deal mainly with problems in mechanics, elasticity and hydraulics and their applications to elastic fatigue and plastic flow of solids and viscous and turbulent flow of liquids.

The first lecture, by V. Bush, on recent progress in analysing machines, describes an optical instrument for the evaluation of parametric integrals and solvers for simultaneous linear algebraic equations and for ordinary differential equations. The second by A. Caquot, on the definition of the elastic domain in isotropic media and intrinsic curves of apparent and true elastic resistance, after a brief review of the relevant classical concepts, treats of the relation between the magnitude and direction of the stress required to produce a permanent strain in concrete and steel, found experimentally and applied to the determination of the elastic limit. J. P. Hartog in the third lecture considers the vibration problem in engineering, with reference to instabilities caused by friction, phenomena in stretched wires and vibration caused by leakage flow.

The fourth lecture, by Th. v. Kármán, treats of some aspects of the turbulence problem, especially the stability of laminar motion, the transfer of momentum, vorticity and heat in turbulent motion, with practical applications, and atmospheric turbulence. In the fifth lecture E. Schmidt discusses the convection of heat for independent flow as well as for flow due to differences of temperature, in both its experimental and theoretical aspects, and the extension of the theory to problems of diffusion. The sixth lecture, by H. Wagner, deals with the steady gliding of bodies along a water surface and the landing and taking off of hydroplanes.

Science and Education in the U.S.S.R.

By Prof. A. Pinkevich. (The New Soviet Library, 12.) Pp. 176. (London: Victor Gollancz, Ltd., 1935.) 3*s*. 6*d*. net.

THE success of the planned economy of the Soviet Government probably depends as much upon education as upon any other single factor. This lucid but admirable account of what has already been done to provide the State with intelligent citizens, industry with competent workmen and efficient technicians and leaders, indicates the extent to which a population 64 per cent illiterate in 1917 is being converted into a nation capable of enjoying the advantages with which modern technology can endow it, as well as producing the technicians required for the execution of its plans. Prof. Pinkevich's survey of the position of scientific work in the U.S.S.R. reveals unparalleled co-ordination of such effort in the service of the national economy.

The Annual Register:

A Review of Public Events at Home and Abroad for the Year 1934. Edited by Dr. M. Epstein. Pp. xii+318+182. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 30*s*. net.

THE troubled history of last year with its many political crises and its social changes and economic problems is fully and impartially recorded in this valuable annual volume. About one third of the book is occupied with the history of Great Britain and the British Empire, the latter arranged under the different Dominions and India. Another third deals with the history of foreign countries, among which even the smallest find a place. The activities of the League of Nations are also reviewed. The final third is devoted to a chronicle of notable events, obituary notes, and lengthy surveys of literature, art, drama, music, finance and law, with fifteen pages of a record of scientific achievement which includes mention of notable books. Several public documents are given in full, including the memorandum on disarmament laid before Parliament on January 31, 1934. A full index enhances the value of the book.

Metallurgy: an Elementary Text-Book

By E. L. Rhead. New, revised and enlarged edition. Pp. xiv+382. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 10*s*. 6*d*.

A BOOK which is forty years old can claim to have established itself as useful. In spite of the fact that large additions have been made in many sections, the total length remains less than 400 pages, a sign that the matter has been condensed. In this edition new sections have been added on pyrometry, metallography and foundry work, and additions made in the sections dealing with fuel, electric furnaces, coking plant and other melting and smelting processes.

The revival of interest and prosperity in our iron and steel and metallurgical industries should attract an increasing number of technically trained men into them; indeed without these the revival will not persist.

Unit Processes in Organic Synthesis

P. H. Groggins, Editor-in-Chief. (Chemical Engineering Series.) Pp. xii+689. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

THE chemist in industry is far more interested in the reaction, mechanism and technique of the processes employed than in the countless new carbon compounds which are synthesised; hence a text-book of organic chemical engineering which deals with the unit processes. Those chosen are nitration, reduction, diazotisation, halogenation, sulphonation, amination, oxidation, hydrogenation, alkylation, esterification, hydrolysis, Friedel and Craft's reaction, polymerisation. There is little doubt that this is the way to teach the subject, and that the new method will in time prevail.

The technical production of the book is excellent.

The Meaning of Biological Classification*

By Dr. W. T. Calman, F.R.S.

IN much of the academic teaching of biology at the present time, the view is expressed or implied that biological classification is meaningless except as a more or less convenient device for filing herbarium sheets or arranging our animal specimens on shelves, the inference being that our search for a natural system of classification is futile, because no natural system exists. It is possible that if we could cross-examine one of those who despise the work of the systematist, we might find him reluctant to go quite so far as this. We all, even the youngest of us, profess to accept the doctrine of evolution, if only as a convenient weapon with which to meet the fundamentalists, and we can scarcely believe in evolution while denying altogether that, in Darwin's words, "community of descent . . . is the bond which, though obscured by various degrees of modification, is partially revealed to us by our classifications". Darwin, indeed, saw clearly, so early as 1842, that "the natural system ought to be a genealogical one" and the idea was old even then. It is implicit in Buffon, in 1766, and Lamarck seems to take it for granted. Why then must we now abandon it, and what is to take its place?

In the 'eighties of last century, a fresh direction was given to morphological thought by the rise of the new branch of biology to which Roux gave the name of *Entwicklungsmechanik*. This was an attempt to explain structure in terms of forces acting during the life-history of the individual organism, and to replace the 'historical morphology' of the period immediately preceding it by 'causal morphology'.

The profound influence which this school has exerted on biological thought is well known. In the passage which I have just quoted from Darwin I omitted one clause: Darwin wrote, "community of descent, the one known cause of close similarity in organic beings". It is not too much to say that causal morphology has revealed other factors besides community of descent as responsible for some of these close similarities. In other words, it has not only proved the possibility, but also explained a method, of convergent evolution on a scale unsuspected in Darwin's time.

This physiological point of view has tended to concentrate attention on those features of organic form that can be demonstrated experimentally to originate as individual responses to the pressure of environment, or to be the inevitable outcome of 'laws of growth' that are the same for organisms in different lines of descent. It has tended to neglect features for which no such explanation can as yet be imagined.

There is, however, one group of biologists who have never quite lost interest in questions of descent. Those who are concerned with the study of fossil animals and plants cannot, if they would, ignore the historical succession of organisms; nor can they altogether avoid speculating on the nature of the links that relate each form to those that precede and those that follow it in the geological time-scale. Here again we find that modern research has led to the recognition of many incontestable instances of parallel and of convergent evolution. I need not illustrate this by citing examples, for the subject was admirably expounded only a few years ago by one of the most erudite and philosophical of palæontologists, the late Dr. F. A. Bather, in a presidential address to the Geological Society. His conclusions were that "the whole of our system, from the great Phyla to the very unit cells, is riddled through and through with polyphyly and convergence", and, in regard to the main subject we are considering here, "Important though phylogeny is as a subject of study, it is not necessarily the most suitable basis of classification".

When these words were uttered, they sounded to some of his hearers like a counsel of despair; and now that their author no longer abides our question, we are left doubting what other possible basis of classification he could have had to suggest to us.

It would be mere presumption on the part of one who is not a palæontologist to criticise on palæontological grounds the deductions of an acknowledged master in that science; but I must confess to a suspicion that things are not quite so bad as Dr. Bather painted them.

The number of instances in which the succession of fossils has been traced upwards through successive strata foot by foot with marvellous continuity must not blind us to the fact that such

* From the presidential address to the Linnean Society of London on May 24.

instances are, in the nature of things, quite exceptional. Darwin's chapter on the "Imperfection of the Geological Record" is, on the whole, as applicable to the state of knowledge to-day as it was when it was written. Many of the phylogenies which have been based upon palæontological evidence are little less conjectural than those based on morphological evidence alone. The main difference (and, of course, a very important one) is that palæontological series can only read in one direction, while we are sometimes in doubt which end of a morphological series comes first.

When these considerations have been allowed for, however, we have to admit that palæontology has revealed instances of convergence that are beyond question, although they are far from proving it to be so all-pervading as Dr. Bather suggested.

It would be easy to multiply instances to show that convergence has been too lightly assumed by some phylogenists as an easy way of getting over difficulties; but, on the other hand, it is impossible to construct a reasonable scheme of phylogeny for any considerable group of organisms without finding it necessary to admit convergence in certain important characters.

When confronted with such examples of convergent, or, as Darwin called it, analogical resemblance, we are tempted to ask where we are to stop. Is structure ever an indication of phylogenetic affinity? Is community of descent ever a cause of organic similarity? Is blood ever, in fact, thicker than water? Dr. Bather, as we have seen, came very near to answering these questions in the negative.

Most morphologists have believed that, however exact the resemblance produced by convergence, investigation would always reveal the underlying evidence of descent. As Darwin put it, "In all such cases some fundamental difference in the growth or development of the parts, and generally in their matured structure, can be detected".

We must, however, beware here of a very ancient type of fallacy.

"Treason doth never prosper. What's the reason?
Why, if it prosper, none dare call it treason."

Convergent evolution, if carried out to the end, would obliterate the evidence of its own existence. Can we believe that it never does so?

I do not profess to have any ready-made and conclusive answer to this question, but it seems to me that it might be helpful to approach it from another side; from the side, namely, of the pure systematist.

Throughout great sections of the animal and vegetable kingdoms the broad outlines of a consistent and symmetrical natural system have now been established beyond all possibility, as it seems, of question. It is true that there still remain very considerable assemblages of both animals and plants of which the classification is still tentative and open to dispute. Since it is upon these debatable groupings that research and discussion have naturally concentrated, we may need sometimes to be reminded how extensive is the territory within which we no longer discuss the natural classification because it has long ago been settled, taken for granted, and put out of mind. Just as, for many of us, fading memories of the Latin grammar consist mainly of lists of exceptions, lingering on after the rules themselves have been forgotten.

It is certain that a natural system does exist. We may never be able to see all the details of its structure, and even its broad outlines may remain, here and there, a little blurred, but the general pattern cannot be mistaken. The framework of the *Systema Naturæ* is something different in kind from the framework of the London Telephone Directory. It is an objective fact, not an arbitrary construction of human inventiveness. It calls for explanation as urgently as, for example, the periodic classification of the elements; and no scientific explanation other than that offered by community of descent has ever been given.

If Dr. Bather and those who think with him were right; if the whole of the system were "riddled through and through with polyphyly and convergence", then it is inconceivable to me that the resulting ruins would have presented anything resembling the coherent pattern that we observe in our approximations to the natural classification of animals and plants. As Darwin pointed out in the fourteenth chapter of the "Origin", the categories of our classification cut across the categories of adaptation and those of environment. To suppose that they can be attributed to inherent laws of growth seems to verge upon mysticism.

I suggest, therefore, that the results of taxonomic research are, in their broad outlines, entirely inconsistent with the view that convergent evolution has been the rule rather than the exception in the phylogeny of animals and plants. It has often played an important part, but never the dominant one.

To know something of the course of evolution is a desirable preliminary to discussing the causes of evolution. If taxonomy can make a contribution towards our knowledge of the course of evolution, then it is a subject worthy of study.

The Institute of Chemistry

By Dr. Bernard Dyer

NEXT week the Institute of Chemistry will celebrate by a banquet and a reception the fiftieth anniversary of the granting of the Royal Charter which, in 1885, rewarded its already many years of effort to establish a definite form of recognition of the profession of chemistry as distinguished from the calling of pharmacy, with which in the lay mind it has been too often confused.

Before the letters F.I.C. or A.I.C. were used to designate fellows or associates of the Institute, there was no specific label by which the analytical and consulting chemist, the teacher of chemistry or the chemical research worker could briefly suggest the nature of his profession, except the vaguely significant letters indicative of fellowship of the Chemical Society—awarded not altogether without discrimination, but carrying with it no diplomatic significance; for the charter of the Chemical Society gave it no power to confer an examinational qualification.

In the late 'sixties and early 'seventies of last century, the desirability of some such distinction was, from time to time, discussed at formal and informal meetings, and in letters and articles in the Press; and in 1875, on the initiative of F. A. Manning, a well-known London analyst, a small organisation committee was formed to endeavour to formulate a definite plan of action. This committee was, from time to time, enlarged and reconstructed, and divers proposals were considered, with the result that two years later, in 1877, the Institute of Chemistry was incorporated under licence of the Board of Trade.

The first president was Prof. (later Sir Edward) Frankland (of the Royal School of Mines), and the other original subscribers to the deed of incorporation were Prof. Abel, Dr. Angus Smith, Prof. J. H. Gladstone, Prof. E. V. Tuson, Prof. W. Noel Hartley, F. A. Manning, E. Neison (later E. N. Nevill), Prof. Galloway, C. T. Kingzett, Prof. J. Attfield, Dr. C. A. Alder Wright, Dr. James Bell, Michael Carteighe, Prof. Crum Brown, and Prof. (later Sir) William Crookes. Of these signatories it is pleasant to be able to record that two are still with us, namely, Mr. E. N. Nevill (known to us then as Neison) and Mr. Charles T. Kingzett. Many chemists who had already given support to the movement in its preliminary stages were registered as original fellows, while admission was offered for the next six months to all whose positions or other evidence of fitness should commend them to the Council. After this, admission was to be restricted to applicants who had gone through a definitely stipulated course of training and experience; and the passing of a practical examination held by the Institute itself was soon prescribed as an additional requirement.

It was during these first six months that the writer of these notes—already in practice as a consultant at an age which would, in these days, surely seem precocious—was elected; but, as he remembers, he had at first to be satisfied with the rank of associate, until he attained the full age of twenty-four years fixed for admission to the title of fellowship. This, otherwise insignificant, incident is mentioned merely to indicate the duration of his association with the Institute and its activities, which is his excuse for yielding to the editorial invitation to occupy this space. The number of fellows and associates of the Institute recorded at the end of its first year was only 275. To-day its roll extends to considerably more than 6,000.

After three years, Prof. Frankland was succeeded as president by Sir Frederick Abel, who in turn was followed in 1883 by Prof. Odling, of Oxford, to whom fell, in 1885, the pleasure of announcing the reception of the Royal Charter, the grant of which forms the subject of the forthcoming Jubilee Celebration. The next president was Dr. James Bell who, in turn, was followed by Prof. (afterwards Sir William) Tilden, during whose time (1891–94), after a nomadic existence in temporary offices and reliance on the hospitality of the Chemical Society for general meetings, the Institute became possessed of a home of its own in Bloomsbury Square. It was also during Tilden's presidency that the Council was fortunate in obtaining the services in its secretarial office of a modest young man named R. B. Pilcher. The post of secretary and registrar had, from the beginning, been filled by Charles E. Groves (the well-known editor of the *Journal of the Chemical Society*) who had recently retired, being succeeded by Mr. G. H. Robertson, whose term of office, however, was cut short by illness. For the time being, Prof. J. Millar Thomson assumed the office of honorary registrar and secretary, with Mr. Pilcher as his lieutenant, and later (in 1900), when Thomson

became president, the full title of registrar and secretary fell to Mr. Pilcher, to whose zeal and energy the Institute owes not a little of its development and usefulness during the last thirty-five years.

Prior to Thomson's elevation to the chair, two other presidents had succeeded Tilden, namely, Dr. W. J. Russell (of St. Bartholomew's Hospital) and Sir Thomas Stevenson, the distinguished toxicologist. The presidency of the latter is chiefly memorable for the institution of the special examination in the analysis of food, drugs and water, and in microscopy, pharmacology and therapeutics, designed to meet the requirements of the Local Government Board (now the Ministry of Health), in considering the qualifications of candidates for appointment as public analysts, and the special diploma of the Institute has ever since been accepted by the Ministry as evidence of competency in this special work.

Succeeding presidents of the Institute were David Howard, Prof. Percy Frankland, Sir George Beilby and Prof. Raphael Meldola. It was during the term of office of the latter that, the lease of the Bloomsbury Square house having expired, the Institute migrated into the present commodious premises which, with the help of a generously supported building fund, it had been able to erect in Russell Square.

Meldola was succeeded in the chair by Sir James Dobbie (the then Government Chemist), whose influence helped to effect a long-contemplated and momentous change in the regulations for admission to the associateship. Hitherto all candidates had to be examined by the Institute itself, but it was then decided that the attainment of high chemical honours at the degree examination of any recognised university should be accepted as sufficient qualification. Promotion to the fellowship, however, was still, as now, to be awarded only after subsequent experience and the passing of a final examination in a special branch of chemistry, pure or applied, unless in exceptional cases in which the carrying out of advanced research, or the rendering of other signal service to chemistry, might be regarded by the Council as justifying exemption.

Later names on the list of past presidents are those of Sir Herbert Jackson, A. Chaston Chapman, Prof. G. G. Henderson, Prof. A. Smithells and Sir Christopher Clayton, while the now acting president is Prof. Jocelyn F. Thorpe (of the Imperial College) who has recently had the satisfaction of announcing that in celebration of its Charter Jubilee the King has been graciously pleased to accord to the Institute His Royal Patronage.

To attempt here any adequate indication of the present multifarious activities of the Institute would be futile; but it should be recorded that it has in Great Britain and in Ireland fourteen local sections, and at least five in the Dominions, all of which hold local meetings for the delivery of lectures and the discussion of papers, while in London advanced 'Memorial' lectures are given from time to time by eminent masters of special branches of science or of technology. The Council is always ready to lend advisory aid in administrative or other matters of public importance in which chemical considerations are involved, and sends representatives or delegates to many external conferences or standing committees. Not the least of the episodes in its history calling for retrospective satisfaction is the very multifarious help, civil as well as military, which, collectively as well as by individual effort, the Institute was able to render to the country during the War.

It should be added that the Institute issues a quarterly journal which records the proceedings of the Council and the activities of the various local sections and other items of domestic interest; and, in addition, often includes editorial articles which are not only informative but also healthily stimulative.

Obituary

Dr. C. E. St. John

CHARLES EDWARD ST. JOHN, who died on April 26 of pneumonia after a short illness, was one of the most lovable of men. Born on March 15, 1857, at Allen, Michigan, he graduated at the Michigan State University and studied afterwards at Harvard and Berlin. He was an instructor in physics at the Michigan State University and in 1897 became assistant professor, and later professor, of physics and astronomy at Oberlin College, and later dean of the College of Arts and Sciences. In the midst of these busy duties he found time in the summer to work at the Yerkes Observatory with Nichols on the measurement of radiation from the stars. At forty-nine years of age he joined Hale at the Mount Wilson Observatory and remained on the staff there until 1929 when he retired. He was made a research associate in 1930 and continued actively working, despite failing health, until the end, his last piece of work (left unfinished) being a general discussion of the problem of solar rotation.

It is as an enthusiastic and most successful

research worker in the general field of solar spectroscopy that St. John will be remembered. Among the problems that he worked at we may mention the gravitational displacement to the red of lines in the solar spectrum in accordance with the general theory of relativity. Closely allied with this was the study of systematic convection currents in the solar atmosphere invoked by St. John to account for anomalies in the observed Einstein effect. A full discussion of the Evershed effect in different levels in the sun's atmosphere in the immediate neighbourhood of sunspots was one of St. John's methods of analysing the layers in which the various Fraunhofer lines originated.

St. John's wide and exact knowledge of the solar spectrum in all its variants made of him a natural leader for the team recently engaged in the revision of Rowland's Preliminary Table of Solar Wave-Lengths, for St. John had been elected in 1922 president of the Commission on Standard Wave-Lengths and Tables of Solar Spectra of the International Astronomical Union. Later, when several of the solar commissions were combined into one—the Commission on Solar Physics—St. John was appointed its president, and he only gave up his active work for the Union a few months ago on account of failing health. He will be greatly missed at the coming meeting of the Union. St. John was also a member of the Commission on Solar and Terrestrial Relationships working under the International Council of Scientific Unions. He was elected an associate of the Royal Astronomical Society in 1917.

Mr. J. T. Cunningham

OF Joseph Thomas Cunningham, whose death occurred suddenly in London on June 5, at seventy-six years of age, it can with truth be said that he, more perhaps than most, through fair weather and through foul, preserved his youthful keenness and eagerness for biological research to the very end of a long life.

Born in London and educated at St. Olave's Grammar School, Southwark, Cunningham went up to Oxford, where his career was brilliant. He was Brackenbury science scholar of Balliol from 1878–81 and obtained first classes in mathematical moderations and in natural science. In zoology he was a pupil of Rolleston, who died in 1881. He was elected to a fellowship at University College, Oxford, in 1882, which he held until 1889.

After working for a time with Ray Lankester, Cunningham spent the winter of 1882–83 at the Naples Zoological Station. His first publication (*Q.J.M.S.*, Jan. 1882) was a review of recent work on karyokinesis. In 1883 he contributed to NATURE a description of the Naples Station, the occasion for which, he says, was the new Department of Comparative Physiology about to be opened there. In July of the same year there appeared two papers on his first researches, dealing with the nephridia of *Patella* and *Aplysia*.

Cunningham's career as a marine biologist commenced when, in 1884, after having been for a short time assistant to the professor of natural history at Edinburgh, he was appointed director of John Murray's floating marine laboratory (the *Ark*) at Granton, with Hugh Robert Mill as his colleague for hydrographical research. From 1887 until 1897 he was naturalist to the Marine Biological Association of the United Kingdom, being stationed at Plymouth until 1895 and then at Grimsby. He published during this time his monograph on the sole, which remains a standard work, and also his book on "Marketable Marine Fishes", in which much of his own research on the eggs and larvæ of fishes was summarised in convenient form. After serving for a period under the Cornwall County Council as lecturer on fishery subjects, he moved in 1902 to London, where he was engaged in teaching zoology, being from 1917 until 1926 lecturer at East London (Queen Mary) College.

Cunningham was a regular attendant at zoological meetings and frequently took part in the discussions. Although in later years theoretical aspects of biology were his chief interest, he seldom failed to direct attention to significant facts not generally known to his audience which had either come under his own observation or, although recorded, had been forgotten. When the present writer first knew him in 1892 his 'Lamarckian' outlook was already well established and he was always proud of the fact that he had received much help and encouragement in his study of the subject from Herbert Spencer. His own views were summarised in his book "Modern Biology: a Review of the Principal Phenomena of Animal Life in Relation to Modern Concepts and Theories" (1928), and his principal original contributions in "Hormones and Heredity" (1922), and "Sexual Dimorphism in the Animal Kingdom" (1900).

Cunningham was much interested in the experimental side of Mendelian work, as well as in experimental physiology, and always had in hand experiments of interest of his own. So recently as 1930, when more than seventy, he went to Marajo, in the mouth of the Amazon, to study the function of the external filaments which develop during the breeding season on the pelvic limbs of the male lepidosiren; there he satisfied himself that the observations he was able to make confirmed a view he had previously expressed, that these filaments emitted oxygen to the eggs and larvæ, which develop and grow in the almost oxygen-destitute water in a burrow in the swamp.

E. J. A.

Mr. H. W. Clinton-Baker

THE death on April 19, at the age of seventy years, after a few days' illness, of Mr. H. W. Clinton-Baker, the Squire of Bayfordbury, removes a well-known Hertfordshire arboriculturist. Mr. Clinton-Baker will be best remembered for his keen interest in conifers, which he had made the hobby of a lifetime. He became the owner of the Bayfordbury estates in 1903 on the death of his father.

Mr. Baker's love for trees was no doubt inherited from his grandfather, Mr. William Robert Baker, who commenced the famous Bayfordbury pinetum in 1837. The Bayfordbury cedars, planted in 1765 by

an ancestor, Sir William Baker, to commemorate the building of the house, are still among the finest in Great Britain. The pinetum, which at one time contained the best collection of conifers in the country, was considerably enlarged by the late Squire, who from time to time made numerous additions to it. Just before the War he commenced the formation of a new pinetum at Bell's Wood on another part of the estate, which he had planted with conifers recently introduced from China and elsewhere.

Between 1909 and 1913, Mr. Baker's interest in conifers took a more definite shape, when he published three handsome quarto volumes of "Illustrations of Conifers" which contained 'close-up' photographs of all the hardy species in cultivation. The letterpress for the work was prepared by the late Prof. A. Henry and Mr. A. B. Jackson, two well-known authorities on the group. These volumes are a valuable contribution to the literature of conifers, and have been of considerable assistance in the identification of the species. A supplementary volume to the series was commenced some time ago, and will be issued shortly. It is deeply to be regretted that Mr. Baker did not live to see its completion.

News and Views

Iron and Steel

WHEN delivering the Christmas lectures at the Royal Institution in 1925 on "Old Trades and New Knowledge", Sir William Bragg took for the subject of one of his lectures the trade of the smith. One of the objects of this lecture was to show how science has been applied to one of the oldest arts, and what it has revealed. Somewhat the same subject, but under the more prosaic title of "Iron and Steel", and dealt with in a different manner, was taken by Sir William Larke for his Friday evening discourse at the Institution on March 22, and this address is reproduced as a supplement in our issue this week. Within an hour, Sir William reviewed the whole history of the manufacture of iron and steel, pointing out some of the outstanding landmarks, referring to some of the chief inventors and touching upon some of the great achievements rendered possible by the metallurgists.

SINCE iron and steel were first used some thousands of years ago, and since iron was as precious as the crown jewels, many unknown inventors all over the world have added their contributions to the art of iron making, but as Mr. Charles Schwab said, every invention of fundamental importance in the modern iron and steel industry is British in origin. Such names as Darby, Huntsman, Cort, Neilson and Bessemer are well known, and the rise of the iron industry in Great Britain may be regarded both as a cause and a result of the so-called Industrial Revolution. Since the Norman Conquest, said Sir William, there may be said to have been three main phases of industrial development. The first extended to the beginning of the eighteenth century, when power was obtained from animals and men, the second lasted nearly a century and a half and may be described as the age of Iron and Coal, while the third phase, that of the development of metallurgy and alloy steels, has only lasted a quarter of a century, and we may be said to be at the beginning of a new era. Iron manufacture has profoundly influenced the standard of life in the past, and its effect on our social organisation is likely to continue to increase.

Dr. Irving Langmuir, For.Mem.R.S.

THE many friends of Dr. Irving Langmuir will note with pleasure that he has just been elected a foreign member of the Royal Society. It will be remembered (see NATURE, p. 768, Nov. 19, 1932) that he was awarded the Nobel Prize for Chemistry in 1932. In referring to this award, it was pointed out that it is to Irving Langmuir that we owe the conception of the orientated monolayer as the state of material at phase boundaries. A clear and simple interpretation was found for many of the phenomena occurring at interfaces, and new light was thrown on such varied subjects as thermionics, heterogeneous catalysis and surface tension. More recently, Langmuir has been investigating the stability of oil lenses on water as determined by the nature of the monolayer of the interface, a problem with many biological implications. In addition, as the late Sir William Hardy first observed, the orientated monolayer on a metal surface plays an important function in lubrication. During the last two years, Langmuir has also made the important discovery that these layers are destroyed by the passage of a rubbing surface, but if the film be made thick enough, self-repair is effected. Finally, with his co-workers, Langmuir has been investigating the conditions of mobility of substances adsorbed in monolayers on metal substrates, one of the factors to be considered when the rates of catalytic actions are under review.

Prof. Max Weber, For.Mem.R.S.

THE election of Prof. Max Carl Wilhelm Weber as a foreign member of the Royal Society gives well-deserved recognition to one whose influence on biological science is of outstanding importance. After earlier work on Crustacea, Prof. Weber soon entered upon his studies of fish, which were eventually to bring him into the front rank of ichthyologists of the day. His contributions to our knowledge of fish fauna have been very great and resulted from his personal travels into the far north, South Africa and the East Indian Archipelago. The fruits of his researches culminated in his comprehensive joint

work with L. F. de Beaufort on "The Fishes of the Indo-Australian Archipelago" published in three volumes between 1911 and 1916. But to biologists in general, Max Weber is probably better known for his able leadership of the Dutch *Siboga* Expedition in 1899–1900. This expedition covered a distance of about 12,000 sea miles in the different basins of the East Indian Archipelago, and was equipped with the best oceanographical apparatus of the time. The reports of the *Siboga* Expedition edited by Max Weber form one of the major contributions to the science of oceanography, and have filled a large gap in our knowledge of the fauna of that region. Weber himself undertook the study of the fishes collected by the *Siboga* Expedition and published in 1913 his great volume, in which no less than 131 new species were described and 240 species recorded for the first time in the Indo-Australian Archipelago. This work he dedicated to his wife, Mme. Dr. A. A. Weber-van Bosse, who accompanied him on his travels and is herself a botanist of great distinction. Prof. Weber is also the author of the most comprehensive text-book on the Mammalia to be found in any language. The first edition of this work, "Die Säugetiere", was published in 1904 in one volume; the second and latest edition, in two volumes, appeared in 1928. Taking a general view of the work, it is the most complete account in existence of the taxonomy and structure of mammals, living and fossil.

Prof. Moriz Benedikt

PROF. MORIZ BENEDIKT, a leading Austrian neurologist, was born at Eisenstadt in Hungary on July 6, 1835. His medical education was carried on in Vienna, where he studied under Hyrtl, Brücke, Skoda, Oppolzer, Rokitansky and other well-known teachers, and qualified in 1859. During the period 1861–75 he was chiefly concerned with electro-therapy and neuropathology. Afterwards he turned his attention to a comparative anatomical investigation of the brain in man and animals, and craniometric and psychological studies. In 1899 he was appointed professor of neurology in the Vienna medical faculty. In addition to a large number of articles on neuro-pathology, most of which were published in the *Wiener medizinische Presse* between 1869 and 1882, he wrote on anthropology, ophthalmology and otology. Like his contemporary, Charcot, he took a keen interest in art, and a few days before his death, which took place on April 14, 1920, at the age of eighty-five years, published an essay on Raphael. His name has been attached, at Charcot's suggestion, to a syndrome characterised by oculomotor paralysis on one side with paresis and tremor of the upper extremity on the other.

Electrical Units and the I.E.C.

THE practical system of units now in use is consistent, in the sense that the product of a resistance in ohms and a current in amperes gives a potential difference in volts; but it suffers from the defect that the units themselves are not those which would most naturally be derived from the fundamental mechanical units. As a consequence, the product of current in amperes and potential difference in volts gives the power, not in the usual mechanical unit (ergs per second), but in joules per second, that is, in watts. A degree of simplicity is maintained by making the relation between the practical and the absolute unit an integral power of ten in each case. We understand that the International Electrotechnical Commission at its meetings last month adopted the proposals of Prof. G. Giorgi (discussed in NATURE of April 21, 1934, p. 597) to regard these units as derived, not from the centimetre-gram-second system, but from a metre-kilogram-second system. In this system, the unit of velocity is the metre per second, so that the kinetic energy of unit mass (1 kgm.) moving with unit velocity would be 1000×100^2, that is, 10^7 times that of a gram moving with a velocity of 1 cm. a second. Thus the unit of mechanical energy on this system is 10^7 ergs = 1 joule, just as in the practical electrical system.

IT is clearly not sufficient to arrange that the product of current and E.M.F. shall give power in watts, but if a further relation is imposed, then the whole system—ohm, volt, ampere, farad, coulomb, henry, joule, watt and weber—becomes definite, and the powers of ten by which these units are related to their C.G.S. counterparts need not burden the memory; they can be recovered at any time by a simple argument. For the additional relation required, Prof. Giorgi assigns the value unity to the present international ohm, and thus makes all the units on his system identical with those of the practical system. An argument in favour of this particular choice, rather than that of current or voltage, for example, is that dimensional formulæ are appreciably simplified if resistance is taken as the fourth independent magnitude, in addition to length, mass and time. The Commission has at the same time endorsed the resolution passed at Oslo in 1930, to the effect that μ_0, the permeability of empty space, should be retained in magnetic formulæ as a physical quantity and not as a mere numeric differing from unity. On the other hand, authors are left free to use the rationalised or unrationalised formulæ, according as the value which they choose to assign to the permeability of a vacuum does or does not absorb the constant 4π.

Archæological Discovery in Crete

A DISCOVERY in Crete, of which the intrinsic interest is enhanced by the recent publication of the concluding volumes of Sir Arthur Evans's "Palace of Minos", in which he deals with the Minoan script, is announced from Athens. A dispatch from the correspondent of *The Times*, which appears in the issue of June 28, states that Dr. Marinatos, director of the museum at Candia, has announced that among antiquities discovered in the Arkalokori district is a copper double axe on which is a three line inscription in characters not previously known in the Minoan civilisation, but bearing some resemblance to those on the famous Phaistos disc. The antiquities with which this inscribed axe was found are dated at about

the sixteenth century before Christ, a period at which the Minoan culture was at its zenith. The discovery is otherwise remarkable in that it includes swords of exceptionally large size, which are said to be greater in number than any other single find of swords ever made in prehistoric Europe. Associated with them were some hundreds of copper axes, a number of silver axes and twenty-seven gold double axes with golden shafts. The claim that the newly discovered script is itself unknown, but bears a resemblance to characters known from the Phaistos inscription, constitutes the chief interest of the find; though it has other points which will intrigue archæologists. In the circumstances, its full publication should be delayed as little as possible, even though this should entail postponement of full discussion.

Soviet Stratosphere Research

IT is learnt from the reports in *The Times* of June 27 and 28 that stratosphere research is very active in the U.S.S.R. It will be recalled that the Russians hold the altitude record of 12 miles for manned balloons made by M. Prokofiev in October 1933, whilst the U.S.S.R. *Stratostat*, which crashed in January 1934, killing its occupants, rose even higher. The present ascent, which was only of 2½ hours' duration, was made from Moscow on June 26, during which time the balloon travelled 100 miles due south. The commander-pilot was M. Kristap Zille, who was accompanied by a physicist, Prof. Alexandre Verigo, of the Central Geophysical Observatory at Leningrad, and a mechanic named Prilutsky. It is stated that during the short flight the altitude reached was more than 9 miles and that the crew landed safely by parachute, apparently as an exercise. Prokofiev's gondola was used, its instruments were landed intact, photographs of the earth were made and varied cosmic ray records taken. It is incidentally stated, though extremely interesting to hear, that the commander had made two other stratosphere ascents in June.

London Transport Scheme

ARRANGEMENTS have been concluded between the Government and the Standing Joint Committee of the London Passenger Transport Board and the main line railways for the development of a transport scheme for London. On June 5, the Chancellor of the Exchequer announced to the House of Commons that a £35,000,000 plan had been concluded. In addition to the extensive schemes included in the Private Bill of the Transport Board, it is intended to electrify the suburban lines of the L. and N. E. Railway in north-east London entering Liverpool Street, and to extend tube railways to give new connexions between these electrified lines and the City and the West End. The high level at which Government credit now stands enables an Exchequer guarantee to be given of loans sufficient to enable the whole undertaking to be started at once. It involves the building of about 12 miles of new tube railways, the electrification of 44 miles of suburban railway and the doubling and electrification of about 12 miles of further suburban railways. In addition, we were glad to learn that trolley buses are to be substituted for tram cars on 148 route miles. These buses, like the cars, are driven by electricity, but they leave the highways more open and much safer for road traffic. It is hoped to complete the works within five years from the date of the loan. Among the improvements, we notice that escalators will be used instead of lifts and will provide ample accommodation for the increased traffic.

Gas or Electricity for Domestic Heating?

THE question of whether to heat our houses by gas or electricity is discussed in an article in the *Nineteenth Century and After* of June by Prof. W. A. Bone. He is naturally proud of the progress made by the gas industry during the past hundred years. He points out that the electrical industry is only fifty years old and has the attractiveness and self-confidence of youth, and so is apt to impress uncritical minds with its superiority. We agree that a London gas consumer buys as much potential heat for 8·6*d.* as would cost an electricity consumer nearly half a crown at 1*d.* per unit. On the other hand, every bit of the electric heat can be utilised, whilst an appreciable fraction of the gas heat passes up the chimney. Electricians are well aware of the relative costs of gas and electricity for heating, and where economy is the primary consideration, water heating by electricity is only advisable in certain cases. We do not agree with Prof. Bone that a chimney is necessary for the suitable ventilation of bed- and living-rooms. Many systems for ventilating rooms have been devised. Possibly in a few years time chimneys will be considered relics of barbarism, and roof gardens will add to the amenity of life. In London, many consumers now get their electricity at 0·5*d.* per unit and are delighted with their electric heaters and cookers, even although they have previously had extensive experience of gas rings and fires. Electricians are continually experimenting, just as are gas engineers; and are remedying some of the defects of the early installations. It is now customary to have the switch for the electric fire about three feet above the floor so that the heat can be regulated without moving an armchair.

Institute of Physics Lectures at Manchester

THE annual lectures on recent advances in physics arranged by the Manchester and District Local Section of the Institute of Physics were held in the Physics Department of the University of Manchester on June 24 and 26. The first lecture was given by Prof. Franz Simon, who is now working at the Clarendon Laboratory, Oxford, and whose researches on low temperatures are well known. He chose as his subject "Low Temperature Research—its Objects and Methods", and gave an account of recent advances in experimental technique whereby temperatures of the order of a fraction of a degree from absolute zero may be obtained. The principles underlying the experimental methods were considered

and reference made to the peculiar properties of certain substances at low temperatures. Prof. M. Polanyi, professor of physical chemistry in the University of Manchester, gave the second lecture, his subject being "Reaction Velocity and Thermodynamics". He discussed the general effect of pressure on the velocity of chemical reactions, using relations deduced in accordance with thermodynamical principles, and referred among other things to the alteration of the equilibrium of reactions due to pressure, the grouping of reactions, and the connexion between reaction velocity and the heat of reaction. He also described recent work on the mechanism of ionogenic reactions. The lectures were well supported by members and friends, and were followed by helpful discussions of the various points raised.

Chemical Industry and Water Problems

THE presidential address of Mr. Edwin Thompson, at the annual general meeting of the Society of Chemical Industry at Glasgow on July 2, dealt with the question of water supply in Great Britain and covered a wide range of topics in that connexion. Mr. Thompson considered the problem of a national water policy to call for immediate investigation. He deplored the spirit of localism which still manifests itself in connexion with every water supply scheme of magnitude, despite the recommendation made nearly seventy years ago by the Royal Commission of 1868 "that no town should be allowed to appropriate a source of supply which naturally and geographically belongs to a town or district nearer to such source, unless under special circumstances which justify the appropriation". He said there is too much selfishness among water undertakings, and that they could do much to relieve the needs of those who have no water supply. He went on to discuss a number of difficulties and problems which are associated with questions of supply: water pollution, rural requirements, misuse and waste of water, the increase during recent years of the *per capita* consumption, diversion of supplies for canals, storage reservoirs, biological factors of storage, sewage effluents into rivers, compensation water, etc. He alluded to and endorsed the necessity for a survey of the water resources of Great Britain and instanced from the report of the British Association Committee the example set in this respect by other nations. The idea of a water grid was dismissed. The valuation of waterworks for rating purposes has a serious financial bearing on the administration and working expenses of an undertaking. The formation of a Select Committee of the Houses of Parliament to go fully into the question of national water supplies made him confident that the anxieties and hardships of the past year will never be repeated.

The Annual Tables of Constants

AT the conference of the International Union of Chemistry, held in April 1934 in Madrid, it was recommended that a substantial part of the funds at the disposal of the Union should be transferred to the International Committee of Annual Tables of Constants, in order to assist in the publication of these valuable tables. This recommendation was passed unanimously by the Union's executive in Paris in last October and confirmed by the national organisations representing the various countries adhering to the Union, such as Verband Deutscher Chemischer Vereine representing Germany, Comité National Belge de Chimie representing Belgium, National Research Council, Division of Chemistry, representing the United States, and so on. The sum thus put at the disposal of the Committee of the Annual Tables is 150,000 francs; the amount indicates the importance which international chemical circles attach to the continuation of the Annual Tables. This sum will be used up for printing the index of the second series (vol. 6–10, 1923–1930), which is now ready. In return for this gift, the Committee of the Annual Tables is going to put at the disposal of the chemical organisations adhering to the Union a certain number of complete sets of the Tables.

Atmospheric Pollution

THE twentieth report on atmospheric pollution issued by the Department of Scientific and Industrial Research (H.M.S.O., 5*s*. net) records observations for the year ending March 31, 1934. This report, like its forerunners, shows that preconceived notions are not always supported by measurement. If the conditions of sampling and test are valid, then the City of London has the most polluted atmosphere observed in Great Britain, and deposits of solids and tar show annual increase. Again, foggy weather, judged by measurement of 'smoke haze', appears to reach greatest prevalence in Westminster, and some of the highest figures for sulphur pollution are also found in London observing stations. Some so-called industrial cities apparently have atmospheric conditions much superior to those in London. London may, however, take comfort from the fact that comparable measurements show that atmospheric pollution in Philadelphia is almost twice as bad. Experience is recorded with the use of a 'candle' of lead dioxide for measuring atmospheric sulphur compounds. Another interesting apparatus has been devised for recording the quantity of light. The light received by a photo-electric cell develops a current which imparts to a condenser a charge. When this reaches a certain amount, it discharges through a neon lamp and causes an ordinary counter to advance one unit. The difference between the records at the various stations is great, and it may be inferred that large improvements in atmospheric conditions are possible by using experience already known.

Epidemic of Green Fly

WE learn from the Ministry of Agriculture and Fisheries that, in many districts in the southern half of England, oats have suffered from severe infestations by aphides or 'green fly'. Similar attacks on grassland have taken place in certain northern counties, including Lancashire. The insects occurred often in swarms, smothering the crops and causing

much damage. The species concerned is a common one which often causes local and temporary injury to grass. Its appearance in epidemic form on cereals is quite unique in recent times. The reasons for the outbreak are unknown, but they are probably associated with the relatively mild autumn and winter and the advanced condition of the crops. The standard control method would be the application of an insecticidal dust by means of a powder sprayer. The necessary equipment, however, is not available on many farms, and expenditure to meet this treatment seems scarcely justifiable in view of the damage that has already been done. It is probable that the aphids will shortly migrate, while natural enemies are already actively at work.

Metals in Food

THE Society of Public Analysts has issued a useful "Bibliography of the More Important Heavy Metals occurring in Food and Biological Material", the period covered being the years 1921–33. The elements dealt with are antimony, bismuth, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, thallium, tin and zinc. Each reference indicates the nature of the information to be found in the paper. The largest sections deal with copper, lead and manganese, which account for half the references quoted. The pamphlet (30 pages) can be obtained from the Editor of the *Analyst*, 85 Eccleston Square, London, S.W.1 (2*s*. to members of the Society; 3*s*. to non-members).

Principles and Design of Precision Gauges

IN these days of motor-cars, electric fittings and so on, everyone learns something of the value of interchangeability of parts and also experiences the disadvantage of finding that a part 'will not fit'. The progress of manufacture, indeed, depends largely on parts being interchangeable, and in mass production it is absolutely necessary to place limits on the permissible variation from standard dimensions. This necessity has given rise to the system of working to gauges, a system which received a great impetus through the manufacture of vast quantities of munitions during the War, and which to-day is perhaps used most extensively in the manufacture of motor-car engines and other parts. From being a comparative novelty, gauging has become a matter of ordinary routine, while the making and testing of gauges has itself become an industry. There will thus be many persons who will be able to appreciate the pamphlet of Mr. R. J. Foster on "The Principle and Design of Precision Gauges for Interchangeability" recently issued by the Association of Engineering and Ship-building Draughtsmen, and published by the *Draughtsman* Publishing Co., Ltd. (2*s*.). In this the reader will find sections on tolerances and fits and limits, plug gauges, pin gauges, external and internal gauges, height and depth gauges and comparators, together with many sketches and useful notes.

International Geological Congress

PRELIMINARY arrangements are announced from Moscow for the meetings of the Seventeenth International Geological Congress, which is to be held in the U.S.S.R. during the summer of 1937, the year of the twentieth anniversary of the Soviet Government. It is proposed that the first half of August should be devoted to the sessional meetings. The special topics suggested for discussion include petroleum, coal, ore-deposits, rare elements, geophysical methods, the Permian system, tectonic and geochemical problems, the relationship of magmatic rocks and ore-deposits to tectonics, and the history of geological knowledge. Three series of excursions, *A*, *B* and *C*, are provisionally arranged, to take place respectively before, during and after the sessions, the whole programme extending from the beginning of July to the end of September. The *A* series includes excursions to the north (Pre-Cambrian and Khibina Complex); the Urals; the south (Crimea and Donets Basin); the Volga Basin; and the Caucasus. The *C* series are on a larger scale and cover very wide regions. They are described as petroleum and stratigraphical (main oil districts and Central Asia); Central Asia (stratigraphy, tectonics and volcanic phenomena; transcontinental (stratigraphy, tectonics and economic geology of Urals to Soviet Far East); and Turkestan-Siberia (Perm, Altai and Kuznetsk). More detailed descriptions will be given later. Meanwhile inquiries are invited and should be addressed to the Organisation Committee of the Seventeenth International Geological Congress, Moscow, 4, Kotelnicheskaya, Naberezhnaya, 17.

A Recent Sunspot

A FAIRLY large group of sunspots has recently been visible whilst crossing the sun's disc on June 23–July 6 in long. 305° and lat. 24° S. Its area on June 28 was 1000 millionths of the sun's hemisphere, of which 850 millionths was the area of the leader spot. When near central meridian passage, which occurred on June 29·9, the group was visible to the naked eye. Though itself not a return of an individual spot of the previous rotation, the recent spot represented a continuation of localised disturbance which has been apparent for the last two months in this part of the solar surface. In an ordinary telescope, the group has been an interesting object with conspicuous 'bridges' across the leader spot in particular. The spectroscope offered, as usual, a further range of observation. On June 26 at $8^h\ 45^m$ G.M.T. a bright eruption took place that was observable visually in the hydrogen *C* line of the solar spectrum and should have been possible to photographic records in the *H* and *K* lines of ionised calcium. The spectrohelioscope showed with perfection the contour of the areas of the brilliant hydrogen (Hα) emission and the dark filaments of gas bordering them at a later stage. The largest radial velocities measured at Greenwich for the absorption filaments were 20 km. a sec. outwards and 60 km. a sec. inwards to the sun. On June 29 at about $8^h\ 45^m$, several moderately large radial

(*Continued on p.* 27.)

Supplement to "NATURE"

No. 3427 SATURDAY, JULY 6, 1935 Vol. 136

Iron and Steel*

By Sir William J. Larke, K.B.E., Director of the British Iron and Steel Federation

NO single element has exercised such a profound influence on the social organisation of mankind as iron. To-day, directly or indirectly, it enters into every moment of our lives, sleeping or waking; the production of our food, our clothing, our homes, our furniture; and without it modern transport by sea, land and air, the distribution of gas, water and electricity, in fact all the amenities of modern civilisation, would be impossible. We are still in the Iron and Steel Age, and likely to become more and more dependent on them for our material well-being.

Fortunately Providence has ordained that 4·44 per cent of the earth's crust consists of iron in various forms. Though widely scattered, it is found in varying degrees of richness in iron content from a trace up to 60–70 per cent. It is usually only described as iron ore when the iron content is at least 20–30 per cent, as the iron is too costly to extract with smaller content. A feature of all early iron production, owing to the difficulty of obtaining a high temperature, which in primitive furnaces seldom exceeded 1,100° C., was the use of iron ore or sand of high iron content, a fact which limits the area likely to have given birth to the iron culture.

The qualities of iron were aptly described by Dr. Ure in his "Dictionary of Arts and Manufactures". "Every person," he says, "knows the manifold uses of this truly precious metal. It is capable of being cast in moulds of any form, of being drawn out into wire of any desired strength or fineness, of being extended into plates or sheets, of being bent in every direction, of being sharpened, hardened or softened at pleasure. Iron accommodates itself to all our wants, our desires, and often our caprices. It is equally serviceable to the arts, to science, to agriculture, and the same ore furnishes the sword, the ploughshare, the cannon and the bomb. It is a medicine of much virtue and the only metal friendly to the human frame. The ores of iron are scattered over the crust of the globe with a beneficent profusion proportionate to the utility of the metal; they are found under every latitude and every zone, in every mineral formation and are disseminated in every soil."

Iron beads and other articles have been discovered under conditions indicating that iron was known as a precious metal in Egypt at least 4,000 B.C. A sickle blade found by Belgoni under a sphinx at Karnac, and a portion of a cross-cut saw found in one of the pyramids by Colonel Vyse, estimated at 3,000 B.C., are the earliest evidence of its use for purposes other than ornamental. Such early iron has been proved to be of meteoric origin, and indeed the word iron in most cultural languages is derived from a root meaning 'something hard from the sky'. This acceptance of its origin was very widespread. According to Zimmer and others, de Cortez, whilst in Mexico in 1519–21, found that the Aztecs possessed knives and daggers of iron, which were prized higher than gold, being of great rarity; but they had no knowledge of how to smelt it, and when asked, stated that the material came from the sky.

Zimmer in his paper on meteoric iron points out that as meteoric iron contains 3 per cent of nickel, the ancients possessed a steel which (when they were fortunate in the mass they used, as it was of very unequal constitution) was not available to mankind by a manufacturing process until 1890. He points out that 99 per cent of the then (1916) known mass of about 250 tons of meteoric iron is ductile. It was not, however, until a famous fall of meteorites was witnessed at L'Aigle in Normandy on April 26, 1803, by thousands of people, that the celestial origin of meteoric iron was generally accepted in modern times. Such iron contains iron, nickel, copper, cobalt, phosphorus, and in most cases in addition sulphur, carbon and silicon, so that it is a highly complex alloy. There is little doubt that all the early iron in North America up to the fifteenth century was meteoric in origin. Man doubtless discovered the existence of terrestrial iron through the accidental fusing of ore in a camp fire, but there is no evidence to show at what date.

* Friday evening discourse delivered at the Royal Institution on March 22.

Earliest remains indicate that the smelting of iron was known in India approximately 1,400 B.C.; and the discoveries at Hallstatt in Styria and Carinthia (the Roman Noricum), in the famous cemetery, where some thousand graves have been investigated, fixes the date of a highly developed iron culture at approximately 1,200 B.C. The importance of the Hallstatt finds is that examples of bronze and iron weapons found side by side, exactly the same in shape and design, show they were made in a transition period from the Bronze to the Iron Age. Dr. Percy in his great work on metallurgy pointed out that the Iron Age must have preceded the Bronze Age, since it was obviously easier for primitive man to have smelted iron than to have made an alloy of copper and tin; but it is suggested that bronze was almost certainly the result of the smelting of an ore of copper and tin found in the same mine, and that the alloy was not until later a controlled mixture.

The evidence in favour of either centre, Europe or Asia, as the birth-place of iron smelting is of necessity speculative. It is significant that both iron and steel are indiscriminately referred to by ancient writers in describing the material, and there is no doubt that, in the early processes of smelting, iron of varying degrees of hardness and varying qualities was produced.

Early remains indicate that the first iron furnace consisted of a hole in the ground lined with clay, in which were set alternate layers of charcoal and iron ore. The product was a mass of spongy iron mixed with slag and charcoal, which had to be reheated and hammered to eliminate the impurities and render the metal fit for forging into weapons and tools. The resulting metal was no doubt soft, and it is recorded of some of the ancient tribes who were iron workers, that when fighting the Romans, who were then armed with bronze, their weapons frequently bent and required to be straightened.* The production of steel of a high quality under controlled conditions seems to have been established in India several centuries before the Christian era.

According to Colonel Belaiew, wootz, the steel from which the famous Damascus swords were made, was produced by a crucible process. The spongy mass of iron produced from the furnace was broken up, remelted in a crucible with charcoal, allowed to cool, and then reheated and hammered several times; finally being hammered into small cakes about 5 in. in diameter and $\frac{1}{2}$ in. thick, called wootz, which was then an article of merchandise carried from India to Damascus and to Toledo in Spain. This process produced a beautiful steel for the purpose, which, when etched with acid, developed a blue watermark known as Damascening. Its constitution was a eutectoid steel of approximately 0·9 per cent carbon, containing segregations of glass-hard carbide of iron, cementite (Fe_3C), which in the process of production had become spheroidal. The steel gave the swords remarkable flexibility when tempered, and the glass-hard spheroidal particles of cementite took and retained a very sharp edge.

Between the soft weapons of the early Iron Age in Europe and the more highly finished steel of the early productions of India, there is the complete range of qualities in iron and steel which ultimately led to the transition from the Bronze Age to the Iron Age. The hard bronze weapons of the Romans were at least a match for those of soft iron produced directly from the ore; but as the production of steel became more general, the steel weapons were able to pierce bronze armour. The importance of iron for weapons was recognised by the Etruscan King Porsena, 507 B.C., who in the conditions of peace prohibited the Romans from using iron, except for agricultural purposes. It seems evident that iron and steel weapons displaced bronze after Marathon, approximately 490 B.C. About the same period the Phœnicians established colonies in Spain and introduced iron making as followed by the Greeks, and during the second century B.C. Spain became the greatest iron centre, and remained so for centuries. The Romans during the second century B.C. adopted Spanish swords, and Toledo blades were famous long before the Christian era. There was a great belief at this period in the efficacy of the qualities of certain waters, particularly the River Salo in the north of Spain, for tempering—a belief that has been revived even in modern times, when competitors of Sheffield have attributed qualities to the local water which were the result of the abilities of the local people.

Although examples of the Hallstatt iron weapons have been found in Great Britain, and according to Ault were the cause of the people turning their attention to iron, the Iron Age seems to have commenced here about 400 B.C. The iron mines of Sussex were famous until the eighteenth century. The advent of iron tools for wood working and for agriculture converted man from a hunter to a farmer, and thence to a capitalist as he accumulated at first stores of grain, and then more and more tools. It was at this stage that iron assumed its first economic importance. From this period until the eighteenth century its influence and importance with regard to social and economic development was of the same character, though increasing in degree. The furnaces in which the ore was smelted with charcoal, consisting of holes in the ground with goat skin bellows, gave way to structures reared above the

* Polybius's account of Addua 223 B.C.

ground, in which were inserted tubes or tuyeres for the blast. These structures were called bloomeries, from the Anglo-Saxon *bloma*, a lump. They were adopted by the Romans and ultimately used with water-driven bellows, and hammers for *forging* or *refining* the iron. This method of production continued well into the seventeenth century.

During the period of the modern history of England, that is, from the time of the Norman Conquest, there may be said to have been three main phases of industrial development. The first and longest phase lasted until the early part of the eighteenth century, being the era in which physical force was only obtainable from the strength of horse and man. It was the era in which the influence of iron became important as an adjunct to wood, in forming the manual tools for agricultural and structural purposes. The second industrial phase lasted nearly a century and a half, and may be described as the age of iron and coal; while the third phase, that of the development of metallurgy and alloy steels, has only lasted a quarter of a century, and we may be said to be at the beginning of a new era.

In the seven centuries of the first period, iron was too costly for general use, except in a very limited way, and its main use was service in war. But so early as the ninth century, the iron horseshoe had been introduced—an invaluable adjunct, which not only adapted the horse to work in regions other than grass lands, but greatly increased his effective pulling power.

The large-scale development of the use of iron, even in the form of manual tools, was delayed due to the difficulty of producing it.

While copper can be melted at a temperature of 1,100° C., and some of the bronzes at a much lower temperature, it requires at least 1,600° to melt steel. Until the difficulties involved in producing material at such a high temperature on a large scale were finally solved, the use of iron was confined to the most essential needs of agricultural implements and arms. At the same time, it must be recognised that, except as a means of improving the efficiency of manual tools and producing them in greater quantity, the need for large-scale production had not arisen and could not arise until the advent of the Machine Age in the eighteenth century.

Cast iron was not used in Europe until about 1340. In the reign of Edward III, iron was of such importance that an act was passed prohibiting the export of any iron, whether made in England or previously imported, under penalty of forfeiting twice as much to the king as was taken out of the country. According to Parker, the iron pots, spits and frying pans were classed among the Crown jewels.

Cast iron was largely used for cannon and cannon shot, which were exported from Ilsenberg in Germany in the fifteenth century; iron stoves were cast in Alsace in 1490. A small iron industry grew up in the wealds of Kent and Sussex, where iron ore and timber were both available; but it gradually acquired a national importance with the advent of cast iron in the sixteenth century, and became notable for the production of cannon which were exported to other countries. In fact, complaint was made that British cannon were used against England in the wars with Spain in the sixteenth century.

Generally it may be said that the iron industry had for some centuries exercised great influence on the development of civilisation. So far as it gave predominance to any particular people over others, it was mainly in the production and improvement of arms and agriculture. Having regard to its limited use, the industry had reached a considerable magnitude in England in the sixteenth century. As timber was urgently required for shipbuilding, legislation was enacted, restricting the production of iron and encouraging its importation. This was so effective that, while there were 300 furnaces recorded in England in 1665, these had been reduced to 59 by 1740. In 1750 a petition was made to Parliament by the tanners of leather in and about the town of Sheffield in Yorkshire, against the bill encouraging the importation of iron from the American colonies, on the grounds that if English iron were not produced, the tanners would be deprived of the oak bark, which was stripped from the oak before it was converted into charcoal.

Thus even towards the middle of the eighteenth century the iron industry in Great Britain was a decaying one, iron and steel being largely imported from Europe and the American colonies. But at this time commenced the most remarkable development of our material civilisation. Abraham Darby at Coalbrookdale had been experimenting with the use of stone coal in the production of iron, owing to the limitations of the use of charcoal. In 1735 he used coke in the blast furnace, and this date marks the birth of the modern iron and steel industry. The blast at this time was still created by the use of bellows driven in many cases by a water-wheel. Dud Dudley had claimed to have smelted iron with stone coal in 1620, but never brought it into general use (see NATURE, 134, 842; 1934.)

The scale of the industry in England may be gauged from the fact that the total production of iron in the year 1740 was only 17,350 tons, which was the second highest production of any country in the world, Sweden then being the highest, owing to her large resources of timber.

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This has enabled Sweden to-day to maintain her supremacy in the production of charcoal iron. She possesses no natural supply of stone coal.

Darby's use of coke for smelting instead of charcoal gradually spread over the whole country, and by 1760 was common practice. This had the effect of transferring the iron industry from the wooded districts of the wealds of Surrey, Sussex and Kent, immediately to the Black Country, and finally to the other coal districts of South Wales, the north-east coast of England and Scotland. The full advantage, however, of Darby's method could not be obtained by the inefficient water-driven bellows then available. By a remarkable coincidence, Watt developed his improved steam engine in 1769. This development was facilitated by the improved production of iron by Darby, but Watt's engine made available to the iron industry vastly increased blowing power, thus increasing the possible temperature in larger furnaces, and modern blast furnace development became possible.

The blast furnace is the most economic means of extracting iron from its ores. The iron is contained in the form of oxides, or in some cases of carbonates, mixed with a gangue material consisting mainly of silica. The furnace is charged with iron ore, coke and in most cases, depending on the nature of the materials used, limestone. The iron oxide is reduced chiefly by the gas passing upwards through the furnace, which contains carbon monoxide produced by the introduction of hot air at the bottom of the furnace. The lime produces an easily fusible slag with the gangue materials of the ore and, as the materials pass by gravity through the furnace, they reach the hearth at the bottom in a molten state where they separate naturally into two layers, the lower being molten pig iron and the upper slag. The final elimination of the oxygen contained in the iron takes place in the hearth. Two tap holes are provided in the hearth, one above the other. From the upper, slag can be withdrawn, and the pig iron flows by gravity from the lower. The iron thus produced contains about 4 per cent of carbon, varying proportions of silicon, and small percentages of impurities such as sulphur and phosphorus, depending upon the ore used or purpose for which the iron is required. Other elements may be introduced, if required, by including suitable materials in the burden charged at the top.

Blast furnace practice has been enormously improved, but the fundamental principles remain identical with those which have characterised the production of cast iron since the fourteenth century, the earliest period in which it was known. But whereas a single furnace could only produce, even so late as the end of the seventeenth century, less than 200 tons a year, and the average output of the charcoal furnace in 1806 was of the order of 700 tons a year, the coke furnaces were by that time producing approximately 1,700 tons a year. The average production of the blast furnace to-day in Great Britain is 60,000 tons a furnace a year, and there are single furnaces in operation producing 4,000–5,000 tons a week. There are some on the Continent, and in India, producing nearly twice as much as this.

The size of the blast furnace is governed to-day by the market requirements of the resultant product, and in Great Britain—the birth-place of the modern iron and steel industry—there is still made a wider diversity in qualities of iron and steel products than in any other country in the world. The volume of production in Great Britain is now the fourth highest, but is still only one quarter in volume of the normal production of the United States.

It should be mentioned that the most important results of the technological improvements in the blast furnace have been the reduction in the quantity of fuel required. The invention of the hot blast by Neilson in 1828 in Scotland reduced fuel consumption from more than 8 tons of coal to 5 tons per ton of pig iron produced, and by 1840 the average quantity had fallen to 3½ tons, but very much lower in many furnaces. The consumption in modern practice depends on the nature of the ore used, and particularly its iron content; but under suitable conditions with suitable materials, 1 ton of pig iron has been produced with a consumption of 15 cwt. of coke (equivalent to say 22 cwt. of coal).

Referring to the enormous increase in the capacity of blast furnaces, it should be noted that in 1878, when the average annual production of pig iron per furnace in Great Britain was approximately 6,400 tons, there were 948 furnaces, whereas to-day there are actually only 96 in blast with an average production of 60,000 tons a year. So late as 1920 there were 481 furnaces in existence, 284 in blast, with an average annual output of 28,000 tons.

It is not an exaggeration to say that the Machine Age and the Industrial Revolution owe their birth to the inventions of Darby and Watt, since by making iron much more readily available, the inventions of that very remarkable period of 150 years from the middle of the eighteenth to the end of the nineteenth century were made possible which resulted in the replacement of handicraft by machines, and revolutionised production.

The production of individual industries rapidly increased with the application of the steam engine and machinery beyond the absorptive capacity of accessible markets, in view of the limitation of transport. Thus, on the introduction of railways in 1825, there existed a surplus of production in

many centres of the country, awaiting distribution. It was the fact that industrial production had overtaken the immediate consuming power of the communities accessible to the producers that created for the railways such a period of feverish activity and prosperity.

The construction of the railways absorbed the greater part of the iron and steel production, even up to 1881. In that year, out of the total production of steel in Great Britain of 1,778,000 tons, 1,000,000 tons was used for rails alone, and in the United States, which in the same year produced 1,000,000 tons of rails, the total steel production was only 1,588,000 tons.

Early railway development was based entirely on iron. While the development of the rail track had passed through the stage of a flat timber wagon way with flat wheels, followed by an edge rail in timber, in the later stages covered with iron, with flanged wheels, it was not until Jessop introduced the edge rail, which consisted of cast iron rails 3 ft. long by 1½ in. with a raised head and flanged wheels, in 1790, that the modern railway track may be said to have been born.

It is of interest to note how the use of iron has passed from what might be termed wrought iron in the prehistoric and early historic period, to the more frequent use of cast iron, particularly after the advent of Abraham Darby. It was not until 1784, with the invention by Cort of the grooved rolling mill for rolling iron bars, and of the puddling furnace for converting cast iron into what is now called wrought iron, that the forged material again became of prime importance.

In 1805 wrought iron rails were produced 15 ft. in length, which was a great advance over the cast rails, which could only be made at that time about 4 ft. long. Wrought iron takes its name from the fact that the iron is refined in a plastic state and never allowed to become molten, the grains of iron being welded and wrought into shape by a kneading process, either that invented by Cort of puddling pig iron, or by direct reduction from the ores, the resultant spongy mass being frequently hammered and reheated to eliminate slag and ash, as in ancient times.

The Delhi Column is perhaps the most remarkable example of ancient wrought iron extant. It was erected by the Majaraiah Dhava about A.D. 320. This column weighs 6½ tons, and is 24 ft. long, 16½ in. in diameter at the foot, and 12½ in. at the top. A sample of the material has been analysed by Sir Robert Hadfield, and proved to be iron of an extraordinary high purity—no less than 99·72 per cent. The means by which so massive an object, of a material of such high quality, could have been produced 1,600 years ago are still a matter for conjecture.

The metal part of wrought iron is pure ferrite crystals. Interspersed between them are minute threads of slag. Slag is not in this case an impurity, because it confers upon wrought iron its powers of resistance to corrosion. Wrought iron is easily forged, and has been used for some of the most important structures in the world, notably the two bridges over the Menai Straits, Telford's suspension bridge in 1825 and Stephenson's tubular railway bridge, 1850. The latter consists of two wrought iron tubes each 1,510 ft. long. As a testimony to the resistance to corrosion of wrought iron, it may be mentioned that only a few links of the suspension bridge have needed to be replaced, and none of the plates of the two tubular tunnels. The weight of wrought iron in the tubular bridge is 10,540 tons, a very remarkable structure, having regard to the period in which it was erected.

At about the same period Robert Stephenson built the high-level bridge at Newcastle across the Tyne. This is one of the largest cast iron structures in the world. It was opened by Queen Victoria in 1849, and carries both road and railway. The total length of this bridge is 1,337 ft. It is 112 ft. above high-water to rail-level. There are six spans of 125 ft. each and the lower roadway is 22 ft. 7½ in. below the rail-level. The total weight of iron used is 5,050 tons and the total cost was £243,000. Cast iron is still an important structural material; the tunnels of the tube railways and the Mersey tunnel are lined with cast iron sections; no less than 80,000 tons of cast iron were used in the construction of the Mersey tunnel.

In 1850, steel was only made in small quantities in crucibles or by cementation, which were long and costly processes. According to Bessemer, this steel, when rolled into bars, was sold at £50–£60 per ton. He desired to produce a metal having the mechanical characteristics of wrought iron, which could be run into an ingot mould in fluid condition. After years of experiment, he finally developed the process associated with his name, the decarburisation of molten iron by blowing air through it in a vessel called a converter.

This invention by Bessemer marked the birth of the modern Steel Age, as it made steel available in quantities much greater and at a cost much lower than was possible in the case of wrought iron. For many purposes steel immediately proved a superior material, being harder to wear and stronger mechanically. It could also be cast, rolled and forged and was thus able to meet all the demands of the engineers in its application to the production of structures and machines. The first Bessemer steel rail was rolled at Dowlais, Glamorgan, and laid on the main line of the

Midland Railway at Derby in 1857, and it proved to have some twenty times the wearing life of existing iron rails.

About 1860 Siemens developed a regenerative furnace in connexion with glass-making. Faraday delivered one of his last lectures in the Royal Institution in June 1862 on the simplicity, power and economy of the regenerative open hearth furnace, but it was not until 1865 that the first experimental plant was erected by Sir William Siemens at the Sample Steel Company, Birmingham, and the furnace for making steel was put to commercial use.

The open hearth Siemens-Martin process was developed by Siemens and Martin in 1864–67. It had the great advantage over the Bessemer process that, whereas the refining in the latter took 20–30 minutes and the degree of refinement was a matter of empirical judgment, in the case of the open hearth process the time required was at least eight hours and the degree of refinement and quality of the product could be tested by means of samples during the process. The result was that a more consistent quality of product was obtained, and the open hearth process ultimately displaced the Bessemer process in Great Britain.

It is interesting to note that with improvements in the process and particularly the control of the qualities of pig iron, which is the key to the control of the quality of the resultant steel, the Bessemer process is again being used for many purposes in Great Britain. For the past fifty years it has been supreme on the Continent.

The next great advance in steel production was the invention by Sydney Gilchrist Thomas in 1877 of the basic process. Thomas originally intended to be a doctor, and was preparing for his matriculation at the age of seventeen years, when his father died. He was thrown on his own resources and accepted a junior clerkship at Bow Street at a salary of £90 a year. He devoted his spare time to the study of science, principally chemistry. Mr. Challenor, in a course of lectures at the Birkbeck Institute in 1870, said: "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune." This fired the imagination of Thomas. Working under great disadvantage in co-operation with his cousin Gilchrist, who was a chemist in a works in South Wales, they ultimately succeeded. His paper on the process, however, in 1878, before the Iron and Steel Institute, was actually not read for lack of interest until an adjourned meeting in 1879. However, this invention was taken up in that year by Messrs. Bolckow Vaughan, of Middlesborough, who were already producing steel by the original acid Bessemer process and desired to use the Cleveland ironstone which was not suitable for that process, but the use of which was rendered possible by Thomas's invention.

It should be stated that the acid process does not eliminate the sulphur and phosphorus from the iron. For this reason the materials charged must be of a high degree of purity, particularly with regard to sulphur and phosphorus content, as these two elements have a deleterious effect on the quality of the finished steel. The materials charged may be either pig iron or steel scrap of suitable quality, or both. The basic process, as invented by Thomas and Gilchrist, removes phosphorus through the action of a basic slag largely consisting of lime, and the sulphur partly by the slag and partly by the action of manganese contained in the basic pig iron. When the steel has been cast from the furnace into the ladle, any residual oxygen is removed by the addition of aluminium or some similar suitable reagent. If decarburisation has been carried out to a greater degree than is required, the carbon content may be brought up to the required figure by the addition of anthracite in the ladle; also other elements as may be required are frequently added in the same manner.

By far the most important immediate result of Thomas's invention was its adoption on the Continent, as it rendered possible the use of the large deposits of high phosphoric ores in Alsace and Lorraine. The result has been the application of the basic process to open hearth practice and the consequent enormous increase in the production of steel throughout a large part of the civilised world, as can be seen from the growth of world production, with a rapidity which has had an influence, the importance of which can scarcely be exaggerated, on the development of population and improvement in the standard of life.

United Kingdom and World Production of Pig Iron and Steel 1835–1934
(in millions of tons)

Year	Pig Iron		Steel	
	World	U.K.	World	U.K.
1835	1·88	1 00	—	—
1845	2 95	1·51	—	—
1855	5 06	3·22	—	—
1865	8 97	4 82	—	—
1869	11·10	5·45	0·42	0·16
1875	13·61	6·37	1·79	0·71
1885	19·33	7 42	6·19	1·89
1895	28·50	7 70	16 65	3·26
1905	53 24	9·61	44·22	5·81
1915	59·70	8 79	65·57	8·55
1925	75 69	6 26	88·93	7·39
1929	97·35	7 59	118·37	9·64
1931	54 73	3 77	68·07	5·20
1932	39 69	3 57	50·11	5·26
1933	48 77	4 14	65·74	7·02
1934	61 34	5 98	78·93	8·86

It is interesting to compare the growth of population in relation to iron and steel production. From 1066 until 1760 the population of England and Wales increased by some 5½ million, considerably

less than one million per hundred years, while in the next hundred years it increased by 13 million. Similarly, iron production increased slowly from possibly a few hundred tons in 1066 to about 50,000 tons in 1760, and then rose rapidly to nearly 4 million tons in 1860. The rapid expansion of iron production not only coincided with, but also may well be said to have made possible the rapid growth of population. It is interesting

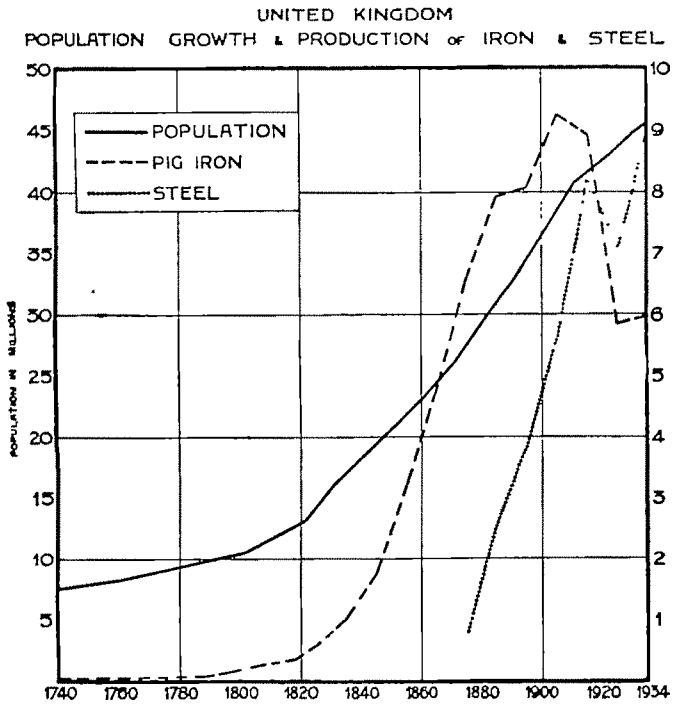

FIG. 1.

to note that the iron output increased much more quickly than the population. Too much significance must not be attached to the relation of these curves, but their general trend shows the paramount influence of the development of iron and steel on population (Fig. 1).

The invention of the basic process was one of the greatest fundamental inventions. Mr. Chas. Schwab, president of the American Iron and Steel Institute, has pointed out that every invention of fundamental importance in the modern iron and steel industry is British in origin, as may be seen from the accompanying table of notable dates:

NOTABLE DATES IN THE IRON AND STEEL INDUSTRY

Payne and Hanbury produced tin sheets, Pontypool	1728
Abraham Darby first used coke in blast furnace	1735
Huntsman produced crucible steel	1740
Smeaton invented blowing cylinder	1760
Watt improved steam engine	1769
Cort grooved rolling mill	1783
Cort puddling furnace	1784
Stevenson's locomotive	1815
Stockton Railway	1825
Neilson invented hot blast	1828
Nasmyth steam hammer	1838
Nasmyth pile driver	1843
Bessemer process	1855
Siemens open hearth steel furnace	1864–67
Thomas-Gilchrist basic process	1877–79

In the third phase of our material civilisation, to which I have referred, and of which we are only in the first quarter-century, we are experiencing a revolution as a result of the application of scientific discovery, which has produced materials possessing qualities as to resistance to corrosion and stress undreamt-of even in the nineteenth century.

In 1832 Faraday, who certainly by his discoveries exercised a wider and more far-reaching influence on our modern civilisation than any other single man, discovered that the resistance of a metal to oxidation was due to the existence of an oxide film which formed on the surface. It was not until nearly a hundred years later that this was conclusively demonstrated by Dr. Ulick Evans in his beautiful research work at Cambridge, by which he succeeded in actually removing the film and examining it microscopically. Faraday had experimented, 1819–24, with a number of alloys of iron with other metals, and was the discoverer of the enormous potentialities of alloy steels. The scope of Faraday's work in this direction was not generally realised prior to Sir Robert Hadfield's examination of the specimens in the possession of the Royal Institution.

The influence of chromium alloyed with iron in facilitating the automatic production of the protective film was first brought out by Monnartz in 1911. The industrial development of this phenomenon can be traced to the research of Mr. Harry Brearley in the Brown-Firth Laboratories, who found that the resistance of iron chromium alloy to nitric acid was increased as the percentage of chromium was increased.

After a long research investigating the limiting ranges of composition giving high resistance to corrosion, Mr. Brearley developed the well-known stainless cutlery steels, containing about 0·3 per cent of carbon and 12–14 per cent of chromium. The rustless steels now available industrially are either chromium-nickel steels or chromium-nickel steels to which other elements such as manganese and silicon have been added.

The variations of this class of steel and the qualities and purposes for which they are used require an exhaustive study in themselves. They are applied to all uses where super-corrosion resistance is necessary, that is chemical plant, aircraft fittings when exposed to the action of acids, manufacturing machinery, general engineering where resistance to abrasion is required or a good cutting edge is necessary. They are largely used in food manufacturing, chemical and textile industries,

but it is obvious from their constitution, in view of the value of chromium which they at present must contain, that they are unlikely, in spite of their high mechanical qualities as regards tensile strength and yield point, to be used for general structural purposes.

There is another entirely different class of steel, which is still made by the crucible process, of which Sheffield is the centre, and of these varieties and qualities and the service for which they are used, the number is legion. One maker since 1860 has produced steels of this quality to more than twenty thousand different analyses. The products vary in value from £45 a ton to more than £800 a ton, and when converted to tool steel, are sold at a price which works out at £840 a ton. In a works of this character, instead of the output being measured in figures of the order of 3,000–4,000 tons a week with 12–20 different sizes and as many different qualities, the production in a typical week was 50 tons with 135 different sizes and 109 different qualities. Hair-spring wire reduced to 9/1,000 in. diameter from a 4 in. diameter ingot, which is drawn through a diamond die in its last stages, has a value of 16*s*. a pound or approximately £1,800 a ton. Ordinary structural steel has a selling price of approximately £8 a ton.

These high-grade steels are used not only in engineering trades, motor cars, aeroplanes, but also by watchmakers and for needles, razors, gramophones, wireless, telephones and electrical instruments and apparatus of all kinds.

Another modern development is the increased resistance to mechanical stress of the alloy steel series, which has rendered possible the development of industrial processes requiring very high pressures, such as the hydrogenation of coal, in which the vessels used have to sustain pressures of three or four thousand pounds per square inch; and high-pressure steam boilers working up to 1,500 lb. per square inch at very high temperatures. These conditions introduce other difficulties, particularly the phenomenon known as 'creep', or the slow expansion of the metal under stress at high temperatures.

The development of alloy steels, both in their qualities of resistance to corrosion and high mechanical stress, has permitted the remarkable development of the aeroplane, the weight of the engines of which in the last few years has been reduced by nearly half for normal service. Radial engines had a weight of 2 lb. per brake horse-power fifteen years ago, and the latest for normal service are 1·2 lb. The first engines used during the War had a weight of 6·5 lb. per brake horse-power and those in normal use to-day are less than 1½ lb. The famous Schneider Trophy engines had a weight of only ¾ lb. per brake horse-power, and there seems little doubt that the normal aircraft engine in the near future will not weigh more than 1 lb. per brake horse-power for ordinary service, capable of 500 hours of operation without overhauling. In the case of the Schneider Trophy engines, it will be realised that they were designed as light as possible for a relatively short period of service.

The improvements in structural material, of which the tensile strength has been raised from the order of 30 tons to the order of 40–50 tons per square inch, have enabled the accomplishment of such engineering triumphs as the Sydney Bridge. This bridge, which spans Sydney Harbour, has an arch span of 1,650 ft. and five steel girder approaching spans on each side of the harbour, making the total length 3,770 ft. It has a total width of 159 ft. 6 in. and takes four lines of rail and six lines of vehicular traffic with two footways. It is 160 ft. above the water-line, and the highest point of the arch is 437 ft. above the high-water level. The arch itself rests on four main bearings. The two arches were built simultaneously from either side of the harbour, each springing from two main bearings and being supported by 128 cables in tension, and were built at such an elevation as to leave a gap of 40 in. to be closed in the centre. The closing of the gap was effected by a gradual loosening of the cables at the rate of about 2 in. a day. When the two half arches were finally brought into contact, they were in perfect alignment, a truly remarkable achievement.

The other great achievement of recent years is undoubtedly the Cunard White Star liner the *Queen Mary*, which, when launched, it was claimed, represented in its mass of 40,000 tons of steel the greatest mass ever moved by man unaided by mechanical power.

What of the future? As an engineer, I am presumptuous enough to think that metallurgy is even yet more of an art than a science. This view I believe is shared by many of our leading metallurgists. When, with the help of physical research, and the application of the ever-increasing means of physical investigation, we are able to ascertain more of the physical structure of the elements with which we are dealing, and thus perhaps predetermine some of the characteristics of the alloys of iron with other elements, we may well open up possibilities in the development of new materials, with such an improvement in mechanical properties as will render possible further developments in our use of mechanical power which may indeed transcend the limits of which we are at present capable. The influence of iron and its derivatives on our social organisation is therefore likely to continue to increase.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

velocities were recorded for about ¼ hour. The minimum of the preceding 11-year cycle having occurred at 1933·8, the present spot with respect to size is not unusual, but it is the largest one seen for more than a year, and its appearance is one of several indications that the new cycle is now well-established.

Announcements

DR. RICHARD ANSCHÜTZ, professor of chemistry in the University of Bonn, has been elected a foreign honorary fellow of the Royal Society of Edinburgh.

IT was announced at the general monthly meeting of members of the Royal Institution on July 1 that the Managers had elected Dr. Edward Mellanby to be Fullerian professor of physiology in the Institution, in succession to Sir Grafton Elliot Smith. The appointment is for a term of three years, in accordance with the provisions of the deed of trust of the professorship. Dr. Mellanby is the secretary of the Medical Research Council, and emeritus professor of pharmacology in the University of Sheffield. It is expected that he will give his first course of lectures at the Royal Institution in the autumn.

DR. R. F. LAWRENCE, who has been assistant in charge of reptiles, amphibians, and arachnids at the South African Museum since 1922, has been appointed director of the Natal Museum, Pietermaritzburg, as from July 1.

DR. HARVEY CUSHING, of New Haven, Conn., has been recently awarded the Gold Medal of the National Institute of Social Science in recognition of "distinguished services rendered to humanity". Dr. Cushing received the Lister Medal of the Royal College of Surgeons in 1930, and is the author of the life of Sir William Osler which won the Politzer prize for biography in 1925.

THE Hungarian Academy of Science has elected as honorary member Baron A. Koranyi, professor of internal medicine at Budapest.

THE annual conference of the Association for Combating and Preventing Corrosion, under the auspices of the Society of German Chemists (Verein deutscher Chemiker e.V., Berlin W 35, Potsdamer Str. 103a), will be held in Berlin on November 18–19, 1935. The subject for discussion is "Corrosion by Water".

THE President of the Republic of Peru has appointed a committee composed of the director of public health, the president of the National Academy of Medicine and Prof. Constantino Carvallo, as representatives of the medical faculty to elaborate a plan for the establishment of a serological institute which, in addition to producing serums and vaccines, will undertake researches in chemistry, bacteriology and biochemistry.

AN Electrodeposition Exhibition will be held in the Science Museum, South Kensington, from July 25 until October. The purpose of the exhibition is to illustrate all phases of electrodeposition and the underlying scientific principles. It has been organised by the Electrodepositors' Technical Society, Northampton Polytechnic Institute, London, E.C.1, from which further information can be obtained.

THE friends, colleagues and pupils of the late Prof. Léon Bernard, formerly president of the Health Section of the League of Nations and physician to the Hôpital Laennec, Paris, desire to honour his memory by placing a medallion of him in his hospital, and founding an international prize for social medicine. A reproduction of the medallion will be given to each subscriber. Subscriptions should be sent to the treasurer, M. Georges Masson, 120 Boulevard St. Germain, Paris, 6e.

A PARTY of Moscow men of science is about to explore the Kara Kum desert in Central Asia. The expedition will be absent for four months, and will investigate the natural resources of areas in the northern and south-eastern parts of the desert.

UNDER the title "Iodine for Livestock", a pamphlet has been issued free of charge by the Nitrate Corporation of Chile, Stone House, Bishopsgate, E.C.2. The pamphlet, which has been compiled by Mr. Frank Corrie, contains several excellent illustrations, and deals at length with the relation between iodine and the various problems of animal health and nutrition, and practical advice is given on the use of iodine in feeding stock.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in engineering in the Plymouth and Devonport Technical College—The Secretary for Education, Cobourg Street, Plymouth (July 10).

A lecturer in production engineering in the Dudley and Staffordshire Technical College—The Clerk to the Governors, Education Offices, St. James's Road, Dudley (July 10).

A lecturer and a student demonstrator in botany in University College, Exeter—The Registrar (July 12).

A chief Government mining engineer in the Department of Mines, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2 (July 15).

An assistant professor of mathematics in the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1 (July 15).

An assistant demonstrator in physics in the Royal Holloway College, Englefield Green, Surrey—The Principal (July 17).

A lecturer in mathematics in the Bingley Training College—The Education Officer, County Hall, Wakefield, Yorkshire (July 24).

An assistant lecturer in civil engineering in Battersea Polytechnic, London, S.W.11—The Principal.

A lecturer in botany, zoology and microbiology in the College of Technology, Leeds—The Director of Education, Education Department, Calverley Street, Leeds, 1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 33.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Adsorption of Aluminium Hydroxide by Kieselguhr

ALUMINIUM hydroxide is readily adsorbed by kieselguhr to form an adsorption complex which is remarkably stable. The hydroxide is deposited by the slow addition of a small excess of ammonia to a de-aerated suspension of 10 gm. of specially purified Superfloss kieselguhr in 100 c.c. of 2 per cent ammonium nitrate solution containing a known amount of aluminium nitrate, the suspension being vigorously stirred. The curve (Fig. 1) shows the relation between the ζ value of the preparations in $N/10$ acetic acid and the amount of aluminium hydroxide adsorbed by 100 gm. of kieselguhr.

This curve indicates that the surface of 100 gm. of kieselguhr is completely coated by 0·00486 gm.-mol. of aluminium hydroxide and that a maximum ζ value of +75·4 mv. is then obtained. Increasing the amount of aluminium hydroxide causes a decrease in the ζ value until a value of +61·2 mv. is reached, when 0·00972 gm.-mol. has been deposited. The deposition of further quantities of aluminium hydroxide does not change the ζ value of 61·2 mv., which is that of free unsupported aluminium hydroxide in $N/20$ acetic acid.

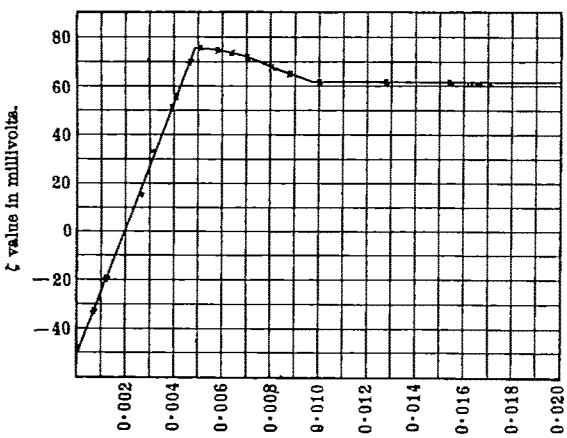

FIG 1.

The total surface area of 100 gm. of the kieselguhr was determined by measuring the rate of sedimentation by the international pipette method, the assumption being made that the particles are spherical. By differentiation of the cumulative percentage curve, the values of $dW/d\log r$ were obtained and from these the values of $dS/d\log r$ were calculated. The area under the $dS/d\log r$, $\log r$ curve gave the total surface area as $1{\cdot}54 \times 10^6$ sq. cm. and it is manifest that this must be much less than the true surface area. If the true surface area be taken as five times that calculated, that is, $7{\cdot}7 \times 10^6$ sq. cm., then when 0·00486 gm.-mol. of aluminium hydroxide completely covers that area the diameter of each particle of the hydroxide on the surface is found to be $5{\cdot}77 \times 10^{-8}$ cm. Since this is of molecular dimensions, it follows that aluminium hydroxide is first adsorbed as a uni-molecular layer by the kieselguhr surface and that when this layer is completed the ζ value is +75·4 mv. It further follows that when a second uni-molecular layer of aluminium hydroxide has been deposited, the ζ value falls to +61·2 mv. and that this second layer has the same properties as the un-adsorbed substance.

Since the number of aluminium hydroxide molecules in the first and second layers must be the same, the enhanced ζ value indicates that the molecules in the adsorbed uni-molecular layer must be activated in some way. The observations, therefore, are analogous to those of de Boer and his colleagues[1].

In explanation of this activation, it may be suggested that an adsorption complex is formed of the type proved to exist in the case of solvates[2]. If the molecules in the surface be denoted by E and those of the adsorbed substance by S, the adsorption complex will be represented by $E^{-}S^{+}$, the molecule E having given one or more of its rotation-vibration quanta to the molecule S. Since this transference of energy cannot take place unless the two molecules have rotation-vibration frequencies in common, a surface must possess a selectivity in its absorptive power. It is interesting, therefore, to note that kieselguhr does not adsorb iron hydroxide ($Fe(OH)_3$) in spite of the similarity between the properties of $Fe(OH)_3$ and $Al(OH)_3$.

E. C. C. BALY.
W. P. PEPPER.

University,
Liverpool.
June 8.

[1] *Physica*, 1, 753, 935, 953, 960; 1934.
[2] B.A. Report, 1928, p. 35.

Spontaneous Super-Contraction of Animal Hair

SUPER-CONTRACTION induced in silk fibres by acid, and in wool by means of steam and chemical reagents, has been described by Farrell[1], Astbury and Woods[2] and Speakman[3] respectively. I have recently obtained evidence of super-contraction in the guard hairs of raw pelts taken from fur-bearing animals, the phenomenon probably arising through oxidation of

the disulphide link in keratin. As the furs had received neither heat nor chemical treatment, the condition described below apparently developed on the living animals. The fibres under consideration are distinguished by extra-normal curvature (Fig. 1*a*) which is generally greatest at the tip of the hair, and has been observed most frequently on the pelts of white and red foxes. The phenomenon may occur locally or be general to the whole skin, and when severe it gives a markedly frizzy appearance to the affected region.

Exposure of these fibres to steam increases the deformation in the same direction: a fox hair, the tip of which was deflected 180° before treatment, shrivelled to a close spiral of four or five turns, and contracted still further on drying (Fig. 1*b*). Immersion in strongly acid solutions reduces (in some cases reverses) the curvature, but subsequent washing and drying leads to an increase in the initial direction. Cold water reduces the curvature of the fibres whether or not they have been treated with chemical reagents or steam, but its action is reversed by drying. The curvature of these fibres before and after treatment can only be explained as due to a small difference in super-contraction of the keratin chains on opposite sides of the fibre.

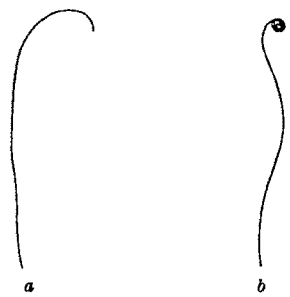

FIG. 1. White fox guard hair showing curvature due to super-contraction: (*a*) untreated; (*b*) steamed 10 minutes and dried. ×2½.

Disulphide and salt linkages between adjacent peptide chains appear to be prime factors opposing the contraction of keratin. When both are attacked, super-contraction occurs, as is evident from experiments carried out by Speakman[4]. There is no evidence that, in the absence of tension, either steam or acid has any rapid effect on disulphide linkages, but either is capable of disrupting the salt linkages[5]. Hence, in the abnormal fibres described, the contribution of the disulphide link to the lateral bonding of the molecules has been reduced sufficiently to permit super-contraction, which is greatly enhanced by opening the salt linkages.

The uncurling of fibres by acid, and the effect of cold water are obviously explicable in terms of swelling. The mechanism by which the disulphide link is attacked is probably oxidation via atmospheric oxygen in the presence of water and under the influence of light (ultra-violet ?) This view is supported by Berger's observation[6] that sulphuric acid is produced in wool by exposure to sunlight. The production of curvature in normal fibres, by reagents that attack the disulphide link and permit super-contraction, is further evidence of the significance of this link in the phenomenon described. Such artificially damaged fibres behave, qualitatively, in the same way as abnormal specimens taken from the raw skin.

As some species appear to be free from the characteristic features described, it would be of considerable interest to know how widespread the abnormality is. I should be glad to hear details of cases in which it has been observed on living animals.

R. O. HALL.

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61 Grange Road, S.E.1.

[1] *J. Soc. Dyers Col.*, 21, 70; 1905.
[2] *Phil. Trans. Roy. Soc.*, *A*, 232, 333; 1933.
[3] *J. Soc. Chem. Ind.*, 50, 1T; 1931. NATURE, 124, 948; 1929.
[4] NATURE, 132, 930; 1933.
[5] NATURE, 128, 1073; 1931. *J. Soc. Dyers, Col* 49, 180; 1933.
[6] *Melliand's Textilber.*, 7, 451; 1926.

Nova Herculis and Cosmic Rays

SINCE the appearance of Nova Herculis in December last year, a number of notes have appeared in various scientific journals dealing with a possible effect of the nova on the intensity of cosmic rays, but the conclusions arrived at by different observers have been rather conflicting. It seems, therefore, desirable to examine as many observations as possible at different places and with different types of apparatus. The data obtained by means of a photographically recording Kolhörster electrometer of the latest type which was kept in continuous action at the Solar Physics Observatory, Cambridge, during the period from February 14 until March 20, appear to confirm Kolhorster's observations made with Geiger-Müller counters.

The instrument was installed inside a box-shaped shield of which the base was made of cast iron blocks of 6 inches total thickness and the walls and the top were made of 100-year old lead slabs of 4·5 inches total thickness. Between February 14 and March 4 the observations were made with the shield closed on all sides, while during the period March 4–March 20 the shield was open at the top. Hourly values of the cosmic ray intensity were determined from the photographic records and all the values were reduced to a common atmospheric pressure (about 29 in.), the pressures during the different hours being obtained from simultaneous barograph records. In order to find out if the nova was making any contribution to the cosmic rays the day was divided into four six-hourly intervals and the average values of the cosmic ray intensity were calculated for the different intervals. The results are given in the following tables:

CLOSED SHIELD (MEAN NOVA MAGNITUDE—3·3m)

Interval (G.M.T.)	Intensity in ion-pairs/cm.³/sec.	Remarks	
13h—19h	1·561	Nova highest	1·561
19h—1h	1 477	Nova lowest } Average	1 492
1h—7h	1 546		
7h—13h	1 452		

Increase = 4·5 per cent

OPEN SHIELD (MEAN NOVA MAGNITUDE—4 6m)

Interval (G.M T.)	Intensity in ion-pairs/cm.³/sec.	Remarks	
14h—20h	2 506	Nova highest	2 506
20h—2h	2·449	Nova lowest } Average	2·449
2h—8h	2 440		
8h—14h	2 457		

Increase = 2·3 per cent

It will be seen that both for closed and open shields the intensity of cosmic radiation is highest during the 6-hour interval during which the nova is also at its highest altitude, but the intensity is lowest when the nova is at its lowest altitude only for the open shield observations. It is difficult to explain why for the 'closed shield' observations the intensity during the 'nova lowest' interval should be next in magnitude to that for the 'nova highest' interval. The observations have been taken at a time when the nova and the sun have been well separated in hour angle. That the observed effect is not due to a solar term can be seen from the following figures:

Closed Shield		Open Shield	
Interval	Intensity	Interval	Intensity
9h—15h	1·486	9h—15h	2 473
21h—3h	1·489	21h—3h	2 472

A detailed examination of the whole series of measurements is in hand, and the results will be published later.

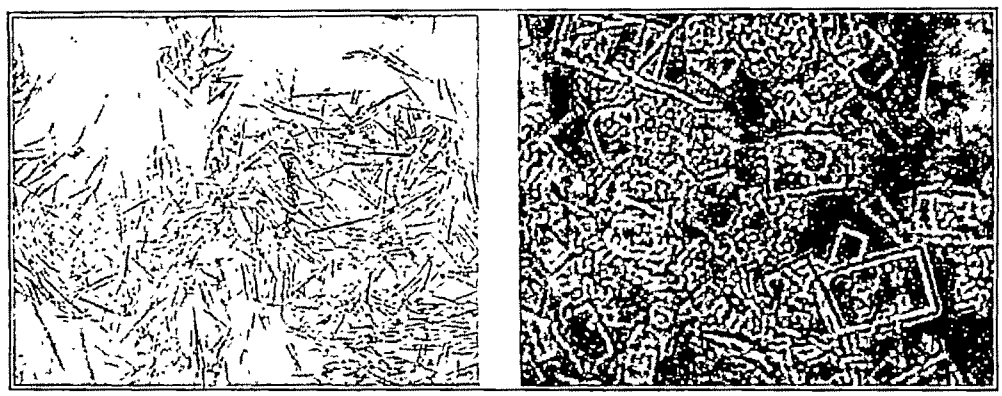
A. K. DAS.

Solar Physics Observatory,
University of Cambridge.
June 19.

Crystallisation of Seralbumins

IN NATURE of February 23, 1935 (vol. 135, p. 307), Dr. Muriel E. Adair and Dr. G. L. Taylor describe crystallised human seralbumin obtained by them.

It will interest readers of NATURE to learn that in the Biological Physical-Chemical Laboratory of which I had charge in the "Instituto Bactereológico" of the National Department of Hygiene (Director, Dr. A. Sordelli) a student of mine, Dr. Moisés Grinstein, made a systematic study of the crystallisation of seralbumin from different species of animals. His work was presented at a meeting on August 16, 1934, of "Las Sesiones Quimicas Argentinas" but the records have not yet been published.



(a) (b)
FIG. 1. Crystal of (a) human seralbumin, (b) guinea pig seralbumin.

Dr. Grinstein tried to obtain crystals of seralbumin from men, horses, asses, mules, guinea pigs, rabbits, llamas, pigs, oxen, dogs and birds, and he obtained positive results with horses, asses, mules, guinea pigs and men.

I enclose photomicrographs of the crystals obtained (Fig. 1).

The technique used was that advised by Sorensen for crystallising horse seralbumin: the globulins are precipitated from the serum or plasma by semi-saturation with sulphate of ammonium. After filtering through paper a transparent liquid is obtained. This liquid is acidified by 0·5*N* sulphuric acid until a permanent turbidity is obtained, shaking continually; this happens when the reaction corresponds to a *p*H 4·6–4·8. After about twenty-four hours the precipitate is completely crystallised.

RAUL WERNICKE.

Buenos Aires.
April 19.

IN addition to the two photomicrographs here reproduced, Prof. Wernicke sent others of horse and mule albumins, but as the crystal form of horse albumin is well known, these photomicrographs are not reproduced. Dr. Adair and Dr. Taylor may be absolved from negligence in being unaware of Dr. Grinstein's work, as it has not yet been published. In the summary of their letter, which appeared in NATURE of February 23, p. 310, it should have been stated that the crystals obtained by them were from normal human sera and not from the sera of dropsical patients.

ED., "NATURE".

Occurrence of Unstable Choline Esters in Invertebrates

LOEWI, DALE, FELDBERG and their co-workers have emphasised the importance and physiological activity of acetylcholine in vertebrates[1]. The possibility of extending to invertebrates the cholinergic mechanisms described in mammals has, so far, not been tested experimentally. The first point investigated at Naples was the existence of unstable choline esters in tissue extracts of marine invertebrates.

Using Chang and Gaddum's technique[2], I have been able to find, in trichloracetic extracts of various tissues of *Octopus vulgaris*, a substance which possesses all the properties of unstable choline esters. Its action on the leech muscle, on the frog's rectus and the longitudinal muscle of *Holothuria stellata* is sensitised by eserine; its inhibitory action on the frog's heart and its vasodilator action in the eserinised cat is abolished by atropine. Like acetylcholine, the substance is destroyed in 10 minutes at room temperature by treatment with 2*N* caustic soda; it is also rapidly hydrolysed by an esterase present in the fresh blood of *Octopus*.

The activity of the same extract in different tests is about the same if expressed in acetylcholine

chloride. Hence it is believed that the substance present in extracts of invertebrate tissues is acetylcholine. The content in the organs of *Octopus* ranges from 0·1–0·2γ per gm. (skin, median ventricle) to 3γ per gm. (arms without skin) of wet tissue. The stomach and posterior salivary glands contain a fair amount (1·3γ per gm.). The blood and testicles have very little or none. The apparent acetylcholine content of *Sipunculus nudus* and of the longitudinal muscles of *Holothuria tubulosa* ranges from 0·9γ to 1·7γ per gm. Choline esterase is present in the blood, not only of *Octopus vulgaris*, but also of *Aplysia depilans* and *Murex*.

It thus seems that, in at least some invertebrates, the conditions for cholinergic nervous action are realised. This second point is now being investigated in *Octopus*.

Z. M. BACQ.

Stazione Zoologica,
Napoli.
May 15.

[1] Dale, H. H., "Nothnagels Vorlesung", Urban and Schwarzenberg, Vienna, 1935.
[2] Chang, H. C., and Gaddum, J. H., *J. Physiol*, 79, 255; 1933.

P.S. The above letter had been sent to the Editor before I saw an advance proof of the communication by Mr. C. F. A. Pantin on the response of the leech to acetylcholine (NATURE, May 25, p. 875). *Hirudo* does not seem to be suited for detailed physiological analysis; *Octopus*, on the contrary, is a remarkable animal for experimental work. In addition to the facts already mentioned above, I wish to add the occurrence of a very large amount of acetylcholine (77γ per gm.) in the cerebral ganglia; this fact suggests that at the central synapses of this cephalopod a cholinergic mechanism is probably involved.

Z. M. B.

May 23.

Dietary Hæmorrhagic Disease in Chicks

A NUTRITIONAL disease of chicks characterised by subcutaneous, intramuscular and abdominal hæmorrhages, prolonged blood-clotting time and erosions of the gizzard lining has been described in detail by Holst and Halbrook[1] of this laboratory. They were able to cure the disease by the use of fresh cabbage. The gizzard erosions and bleeding tendencies have been noted by McFarlane, Graham and Hall[2]. Dam and Schönheyder[3] have also produced the hæmorrhagic symptoms in chicks, and have shown that the disease is not caused by lack of any of the known vitamins. The same finding has been obtained by Halbrook[4].

Dam[5] has reported that the disease is caused by lack of an organic substance which was found present in hog-liver fat, hemp seed, tomatoes, kale and, to a less degree, in many cereals. The anti-hæmorrhagic factor was found to be present in the fat-soluble, unsaponifiable, non-sterol fraction.

Since the first publication from this laboratory[1], additional findings have been made. The disease can be prevented by so little as one half per cent of dehydrated alfalfa, and the anti-hæmorrhagic factor is located in the unsaponifiable, ether-extractable portion of alfalfa. Completely extracted alfalfa, chlorophyll and the saponifiable fraction of alfalfa ether extract fail to prevent the disease. The factor can be adsorbed from its ether solution by activated carbon. It is stable to heating at 120° C. for 24 hours.

The disease can be prevented by a concentrate prepared from alfalfa and fed at the level of 1/1,000 per cent of the basal diet. This basal diet consists of fish meal 20, dried brewer's yeast 12, polished rice 65, limestone 1, cod liver oil 1 and salt 1. Birds on the basal diet develop the disease to a severe extent, comparable with that described by Dam and Schonheyder[3].

In addition, the fish meal used in our basal diets can protect against the disease if allowed to remain in a wet condition for several days, thus affording opportunity for the action of micro-organisms. Rice bran treated in the same way will also afford complete protection, while the untreated rice bran fails to prevent the disease. A sample of the fish meal, completely extracted with ethyl-ether and kept in a moist condition for several days, will, after drying, yield a potent ether extract effective in small amounts when added to our basal diet containing the untreated fish meal.

For these reasons, anti-hæmorrhagic power cannot be attributed specifically to any feed ingredient unless the possibility of action upon it by micro-organisms has been guarded against. These results offer an explanation for the failure of Cribbett and Correll[6] to obtain symptoms of the disease on the Holst and Halbrook diet, and for the fact that samples of fish meals, meat scraps and commercial casein have often failed to produce the disease.

In an experiment to determine a possible causative factor in fish meal, the fish meal was diluted with varying amounts of a mixture of purified casein and bone ash compounded so as to resemble the fish meal. The sample of fish meal used in this case was a different lot from that formerly used although obtained from the same manufacturer. When this fish meal alone was used as the animal protein, the symptoms were only moderately severe. However, the severity and early onset of the disease markedly increased as the proportion of purified casein replacing the fish meal increased. The severity of the disease was also noticeably greater on lower levels of dried brewer's yeast. The results indicated the presence of small but inadequate amounts of the anti-hæmorrhagic factor in both of these samples of fish meal and yeast, rather than a specific disease-promoting factor in the fish meal.

Replacement of 50 parts of polished rice by wheat or yellow corn fails to prevent the disease. The results indicate very little, if any, of the anti-hæmorrhagic factor in these cereals.

In regard to the chemical and physical properties of the anti-hæmorrhagic factor, our work closely agrees with that of Dam[5]. The nature of this substance is being actively investigated.

H. J. ALMQUIST.
E. L. R. STOKSTAD.

University of California,
Berkeley.

[1] W. F. Holst and E. R. Halbrook, *Science*, 77, 354; 1933.
[2] W. D. McFarlane, W. R. Graham, Jr., and G. E. Hall, *J. Nutrit.*, 4, 331; 1931.
[3] H. Dam and F. Schonheyder, *Biochem. J.*, 28, 1355; 1934.
[4] E. R. Halbrook, Thesis, University of California; 1935
[5] H. Dam, NATURE, 135, 652, April 27, 1935.
[6] R. Cribbett and J. T. Correll, *Science*, 79, 40; 1934.

An Insulin Inhibiting Agency in the Duodenum

HELLER[1] and Labarre[2] have reported that some of their preparations of the insuletropic hormone failed to demonstrate the usual increase in sugar tolerance in animals, and are unable to ascribe this to any definite cause. Others also report inconsistent results. Since 1929, using a method reported in conjunction with N. B. Laughton[3], I have noted that it is extremely critical, and deviation at one stage yields negative results.

The inertness of the preparations could not be ascribed solely to mere deficiency in the hormone content, since, while such preparations did not affect the blood sugar values of normal rabbits, these animals displayed a distinctly lowered sugar tolerance. Also such preparations were hyperglycæmic in their action on diabetic patients.

Striking effects were obtained where 'inactive' preparations were investigated on the insulinised rabbit. Controls were given 1 rabbit unit of insulin per 2 kgm. weight and the blood sugar values observed for 6–8 hours. These invariably gave the usual response—the sugar values dropping to 50 mgm. within 2 hours and remaining at this level for 3–4 hours longer. Afterwards, these same animals were treated with the defective preparations and then this standard amount of insulin administered. In some cases no fall in the blood sugar was observed, while in average cases the blood sugar values did not fall below 70 mgm. in 2 hours, and returned rapidly to 100 mgm., usually reaching 130–150 mgm. 4 hours after administration of insulin.

The failure to observe the customary effects of the insuletropic hormone was due to the preponderance of this insulin antagonistic element. After this had been separated, the preparations became insuletropically active, although extreme activity could be developed by further treatment.

The effect of the insulin inhibiting principle, like that of the insular hormone, persists for some weeks after its discontinuance, and a study of this factor in cases of hyperinsulinism is in progress.

The methods by which the above results were obtained will form the basis of a subsequent publication.

A. BRUCE MACALLUM.

Department of Biochemistry,
University of Western Ontario,
London, Ontario.
May 29.

[1] Heller, *Archiv. Exp. Path. u. Pharm.*, 177, 127; 1934.
[2] Labarre, *Bull. Acad. Roy. Med. Belg.*, 12, 620; 1932.
[3] Laughton and Macallum, *Proc. Roy. Soc.*, *B*, 111, 37; 1932.

Experimental Deafness

CONTINUED investigation similar to that described elsewhere[1] has provided evidence for the view that the phenomenon designated 'auditory fatigue' by Ewing and Littler[2] and Rawdon-Smith[1] is in reality the result of the intervention of certain cortical factors. The marked decrease in sensitivity of the human ear following upon stimulation by loud pure tones for several minutes is, it has been found, not confined to the ear stimulated. The nominally unstimulated ear suffers a loss of sensitivity sometimes as great as that in the stimulated ear. Further, the loss of sensitivity in either may be temporarily removed or lessened in many cases by subjecting the observer to an unexpected stimulus (such as momentary darkness). This will be clear from Fig. 1.

It would seem, therefore, that the phenomenon of so-called auditory fatigue may more correctly be termed *inhibition*. The result of an unexpected stimulus is to produce momentary disinhibition.

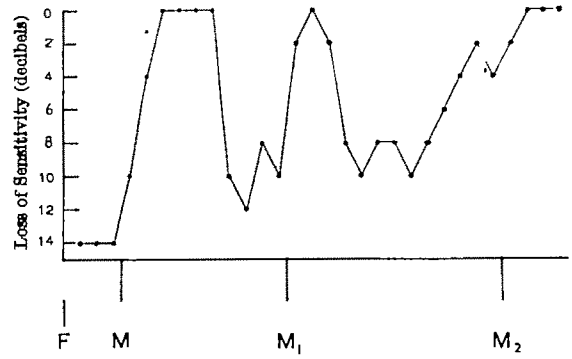


FIG. 1. Chart from actual record obtained from male subject. Each point represents one threshold reading. The points have been joined merely for convenience of interpretation—there is no indication that the threshold would fall on the line between readings. Frequency of stimulating and test tones = 2000 cycles per second. The stimulating tone ceased at F; M, M_1, M_2, represent points of application of momentary darkness in the sound-proof room in which the tests were made.

These effects find their nearest parallel in the phenomena of inhibition and disinhibition (or inhibition of inhibition) of conditioned reflexes described by Pavlov[3].

It is hoped shortly to publish these results in greater detail.

A. F. RAWDON-SMITH.

Psychological Laboratory,
Cambridge.
June 10.

[1] A. F. Rawdon-Smith, *Brit. J. Psychol.*, 25, 1, 77; 1934.
[2] A. W. G. Ewing and T. S. Littler, *Brit. J. Psychol.*, 25, 3, 284; 1935.
[3] I. P. Pavlov (tr. G. V. Anrep), "Conditioned Reflexes" Oxford Univ. Press, 1927.

The Band Spectrum of NH

IN the course of our investigation of the spectrum of discharges through streaming ammonia, it has been possible to record the λ 2530 band of NH, described by Hori[1], with a Hilger E.1 quartz spectrograph, using an improved type of hollow cathode. In addition, we have obtained four weaker bands at λλ 2730, 2835, 2885 and 2980 which appear to be due to the ion NH+.

Our analysis with higher dispersion shows the necessity for revising Hori's interpretation of the λ 2530 band. The initial level is found to be $^1\Sigma^+$, while the final level is identified with the $^1\Pi$ level common to the λ 3240 band ($0,0\,^1\Pi \rightarrow {}^1\Delta$) and the λ 4502 band[2] ($0,0\,^1\Pi \rightarrow {}^1\Sigma^+$).

Full details will be published shortly.

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University College, London, W.C.1.
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June 6.

[1] *Z. Phys.*, V, 59, 91; 1930.
[2] NATURE, 135, 508, March 30, 1935. Cf. also forthcoming paper in *Proc. Roy. Soc.*, A.

The Classification of Coals

I HESITATED to answer the letter published in NATURE of June 1 from Prof. Bone because so long ago as the year 1918 he indicated to me with emphasis that he did not desire any co-operation between chemical and palæobotanical work on coal.

May I, however, point out that he incorrectly says that the terms vitrain, clarain and durain are "imported from France". They are words coined *de novo* by myself in my paper in the *Philosophical Transactions of the Royal Society* in 1919. They do not correspond to the popular 'bright' and 'dull' coal, but were originally diagnosed for ingredients recognised as containing materials with distinct physical properties, and different types of cokes.

That Prof. Bone does not adopt my nomenclature or care to see the differences perceivable to others is a matter for his own orientation about which argument is unsuitable. But he is surely ill-informed to imply that "outside the exclusive circle of the 'Coal Research Club'" these ingredients do not receive recognition. A complete bibliography of coal research since 1919 would show how widely they are adopted. He is briefly answered by the words of M. Duparque (secretary of the Geological Society du Nord), *not* a member of the Coal Research Club, who, writing in 1924 of the laminations in coal, cited the important works of Bertrand, Renault, Grand 'Eury, Wheeler, Seyler, Potonie, Zalessky and others and said: "De tous ces travaux, ceux de Madame Marie Stopes ont eu la plus grande influence sur la direction de toutes les recherches concernant la houille".

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Stationary Optical Paths

REFERRING to Dr. Karl Darrow's[1] article on quantum mechanics, Mr. T. Smith[2] has pointed out that optical paths are not (as Darrow repeats in his article) paths sometimes of maximum and sometimes of minimum time; but that the time is a minimum if the path does not include an image of an end point, and if the path includes an image then the time is neither a minimum nor a maximum. Smith has further elucidated this point in connexion with Darbyshire's[3] recent letter.

The close analogy so significant on wave mechanics between the principle of least action in classical mechanics and the principle of stationary time for optical paths (Fermat's principle) is well known. The principle of least action[4] states that the action is a true minimum, provided that in passing along the trajectory of the particle the final point is reached before the kinetic focus of the initial point. But when the kinetic focus of the initial point is reached before we arrive at the final point, the action is neither a maximum nor a minimum. The definition of the kinetic focus is akin to the definition of image given by Smith in his recent note. Thus we see that the relationship between Fermat's principle and that of least action is not fully exhibited unless we take into account for optical paths the facts emphasised by Smith and so often ignored in text-books on optics.

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[1] Darrow, "Reviews of Modern Physics", 6, 23; 1934.
[2] Smith, NATURE, 133, 830; 1934
[3] Darbyshire, NATURE, 135, 586; 1935.
[4] Whittaker, "Analytical Dynamics" (1927), Section 103.

Points from Foregoing Letters

FROM the amount of aluminium hydroxide adsorbed by kieselguhr (diatomaceous earth) and from the resulting electrokinetic potential (ζ) of the particles, as shown by their movement in an electric field, Prof. E. C. C. Baly and Mr. W. P. Pepper conclude that aluminium hydroxide is first adsorbed as a unimolecular layer giving a ζ-value of 75·4 millivolts. This layer is then able to adsorb a second molecular layer, resulting in a drop in the value of ζ to 61·2 mv.

Super-contraction of animal fibres has been induced artificially by various means. Dr. R. O. Hall describes a naturally occurring example of the phenomenon and proposes a tentative explanation in terms of the disulphide linkage of keratin.

Dr. A. K. Das gives results obtained by means of a continuously recording electrometer which was in action at Cambridge from February 14 until March 20. These photographic records appear to confirm Kolhorster's observations, made with Geiger-Müller counters, indicating an increase in the intensity of cosmic rays during the hours when the star Nova Herculis was at its greatest altitude.

Following upon the recently-published note in NATURE by Dr. Adair and Mr. Taylor, who had succeeded in obtaining seralbumin from normal human sera, Prof. Raul Wernicke now submits photomicrographs of crystals of human and guinea pig seralbumin obtained last year by Dr. Moisés Grinstein of Buenos Aires, and describes the method used in obtaining the crystalline preparations.

Having succeeded in extracting from various organs of the *Octopus* and other invertebrate marine animals a substance giving the physiological reaction of unstable choline esters, Dr. Z. M. Bacq infers, as C. F. A. Pantin did recently, that the rôle of acetylcholine in the nervous mechanism of invertebrates is similar to that in the higher animals.

Mr. H. Dam recently indicated the existence in hog liver fat, tomatoes, etc., of a new vitamin, K, which prevents a deficiency disease in chicken, leading to bleeding tendencies and other symptoms. H. J. Almquist and E. L. R. Stokstad point out that the new vitamin is also present in dehydrated alfalfa and in fish meal or rice bran that have been kept in a wet condition.

Prof. A. Bruce Macallum describes experiments indicating that certain extracts from the duodenum contain, in addition to the hormone which stimulates the secretion of insulin, a further component which is antagonistic to insulin.

The effect of unexpected stimuli in reducing or eliminating experimental deafness produced by loud 'pure' noises, and the fact that such deafness extends to the other ear even when it is not directly exposed to the noise, leads Mr. A. F. Rawdon-Smith to attribute the so-called auditory fatigue to an inhibition effect in the brain cortex rather than to a local effect in the ear.

Research Items

Roman Fort at Brough

THE existence of a Roman fort at Brough, Yorks, where Ermine Street crosses the Humber, as distinct from a riverside settlement, has been determined only recently. In 1933 an investigation was made of the character of the Roman occupation, previously well attested by frequent finds of coins, sherds, etc., by trial trenches dug in the Bozzes Field by Mr. T. Sheppard, Dr. J. L. Kirk and Mr. Philip Corder. In an interim report by the last-named (Hull Museum Publications, No. 182) a number of facts were established, notwithstanding that at the time of writing the excavation was not complete. A military station involving at least two, and probably three, ditches was established at Brough before the campaigns of Cerialis and Agricola. On the south side, the two outer ditches had been levelled and succeeded by an occupation area represented by floors, hearths and a rubbish pit. In the rubbish pit were Roman sherds, imitating Belgic forms, dated from material from Colchester at somewhere between A.D. 56 and 76. From these the inference is drawn that the occupation antedates the campaign of Cerialis, who founded Malton and York in the seventies. The earliest rampart on the east side was of compact sand and has not yet been positively dated. It is probably contemporary with the ditches on the east and south sides of the fort. Eventually the rampart was cut back and a solid stone revetment added. This was probably in the second century. Sherds from the filling of the ditches are none of them later than the Antonines. Probably the ditches were filled in the second century, when the military occupation was moved to the northern frontier. Third and fourth century occupation is attested by coins and pottery, and a large rectangular building in Trench 1 must fall within these centuries. It is not aligned with the ditches and may have been built after they had ceased to exist. Pottery of the fourth century was found unstratified in considerable quantity.

Bay Islands' Culture, Honduras

'LAS ISLAS DE LA BAHIA', a little-known group of islands off the northern coast of Spanish Honduras, have been investigated by expeditions of the American Museum of Natural History (1931) and the Smithsonian Institution (1933), and archæological collections were made in 1930 and 1931 by Mr. Mitchell-Hedges on behalf of the Museum of the American Indian, Heye Foundation. In a study of the archæology of the islands by Dr. W. D. Strong (*Smithsonian Misc. Collect.*, 92, 14) the observations of the two expeditions are combined and the material collected by Mr. Mitchell-Hedges is used for purposes of comparison. The majority of the known archæological sites are on hill-tops, next come caves and rock-shelters; springs and water-holes and large level sites are less frequent. The majority of the sites are shrines, or places of offering of some sort; habitation sites are rare, only four being known, of which one is doubtful, though showing the only known example of, possibly, the foundation walls of a house. Low earth mounds contain scattered burials. The pottery is classified as Monochrome, Elaborate Monochrome, Polychrome i and Polychrome ii, a chronological sequence in which Elaborate Monochrome and Polychrome i seem to be contemporary. The Bay Islands' culture lies on the northern fringe of an important, but little-known, cultural region. It appears to have certain affinities with Maya culture, but this is late and indirect, whereas the affiliation with the western Nicaraguan and northern Costa Rican culture is both intimate and direct. Southern traits permeate the whole culture, and seem to be early and basic. Historical evidence, ethnology, archæology, and linguistics, all combine to suggest that peoples of South American affiliations must have been responsible for most of the remains on Bay Islands and probably for those of northern Honduras as well.

Factorial Analysis of Human Abilities

IN the *Human Factor* (9, No. 5) Prof. Godfrey H. Thomson states briefly, and in as non-mathematical a way as possible, his criticism of Prof. Spearman's 'Two-Factor Theory'. He regards g as a mathematical variable without any real existence as a separate entity; and argues that the g arrived at by one set of tests is not necessarily the same as that arrived at by another set of tests. He refers to the American work on factorial analysis, which has been concerned with applying the method to any team of tests, and not only hierarchical teams of tests, and points out that an infinite number of mathematically satisfactory results are possible. Prof. Thomson gives illustrations to show the innumerable interpretations that could be made from any one set of correlation coefficients. Determining which of them should be selected is the business of the psychologist, not the statistician. His own belief is that the mind cannot be divided up into unitary factors, but is "a rich comparatively undifferentiated complex of innumerable influences".

Musculature of the Blue Crab

MISS DORIS M. COGHRAN has studied the musculature of the blue crab, *Callinectes sapidus*, Rathbun (Smithsonian Miscellaneous Collections, vol. 92, No. 9 (Publication 3282), Jan. 1935). This is an excellent piece of work and one much wanted, for few accurate observations have been made on such an important subject. The chief myological publications in existence relate to crayfish, shrimps and prawns. The complete fusion of the segments of head and body in the crab has resulted in the disappearance of those intersegmental muscles which, in crustaceans like the shrimp and crayfish, give a high degree of flexibility to the movements of the body. On the other hand, the muscles of the appendages are highly complicated, as are also those of the stomach with its gastric mill and of the alimentary system. The abdomen of the blue crab, in the male at least, is apparently progressing towards a condition of partial rigidity, as the third, fourth and fifth segments are immovably fixed in that sex. This fusion is not yet completely established, as the former segmentation is still partly

maintained in its musculature. The female's abdomen has six distinct segments, all of which have the muscles well developed. All these muscles are described in great detail, and there is a discussion of the general structure of the crustacean appendage. The numerous illustrations in the text add much to the value of this undoubtedly valuable work.

Marine Fauna of the Dutch East Indies

NEW parts of Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique (*Mém. Roy. d'Hist. Nat. de Belgique*, Hors série, Vol. 11) recently published embrace Opisthobranches and Silicodermes (Onciades) by A. Labbé; Prosobranches Parasites by W. Adam (fasc. 14); Sponges by H. V. Brondstad (fasc. 15) and Cephalopoda by W. Adam (fasc. 16). A. Labbé has discovered that the Oncidiidæ possess a siliceous armature, hitherto unknown, and that the different members of the family have in their bodies more or less widely distributed spicules of silica. For this reason he has proposed the sub-order Silicodermatæ, being synonymous with the Oncidiidæ of Gray. Not only has he made this innovation, but he has also placed them among the Opisthobranchs rather than the true Pulmonates, for he is of the opinion that the Silicoderms play the same rôle with regard to the Opisthobranchs as the Pulmonates do with regard to the Prosobranchs. Seven species were taken by the expedition, five *Oncidium*, three new, two already known, one not determined owing to bad preservation, and one *Oncidiella*. No mention is made of the very careful monograph on South African Onchidella by Hugh Watson (*Ann. South African Mus.*, 20, 1925) which contains valuable anatomical work and discussions on the geographical distribution. The capulid *Thysa crystallina*, parasitic on the echinoderm *Linckia*, is described by W. Adam, who has discovered the minute male, hitherto unknown, under the shell of the female. The male is mature although less than a millimetre in length and has no disc of fixation. The author, agreeing with Jonker, determines that this disc, which has been subject to much discussion, is part of the head, being innervated exclusively by the cerebral ganglia.

Pacific Entomological Survey

Two publications (Nos. 6 and 7) of the Pacific Entomological Survey have been issued as Bulletins 113 and 114 of the Bernice P. Bishop Museum, Honolulu, 1935. Bulletin 113 is concerned with reports of various specialists on the insects and other arthropods collected in the Society Islands. Bulletin 114 comprises the second instalment of reports on the insects, arachnids, etc., obtained in the Marquesas Islands. These two bulletins are well illustrated and contain descriptions of numerous species hitherto unknown. The bulletins are of interest to students of geographical distribution and of island life in particular, as well as to specialists in the diverse groups concerned.

Physiological Differences between Geographical Races in Forest Mice

INVESTIGATION of the effect of mountain climate upon the human organism has shown that the ascent of high mountains causes an increase in the hæmoglobin content and in the number of erythrocytes in the blood. It is known also that these values are higher in the blood of some mountain animals, as well as of men living normally at high altitudes. The nature of these differences, however, have remained unknown; they may represent either a temporary individual adaptation (as in the case of a man ascending a mountain peak), or they may become fixed during individual or phylogenetic development. Some light on this interesting problem has now been thrown by Kalabuchov (*C. R. Acad. Sci.*, Leningrad, 2, No. 1, 1935) who has made a comparative experimental study of two sub-species of the forest mouse, *Apodemus sylvaticus ciscaucasicus* living at high altitudes, and *A. s. mosquensis* from the plains. Careful counts of the number of erythrocytes proved that the number was constantly higher in the mountain race than in that from the plains. When mice of the mountain race were transferred to the plain, the number of erythrocytes in their blood at first decreased, but two months later the number became normal, and even rose somewhat above the normal. In the controls, consisting of an equal number of plains mice race kept with the experimental animals, no change in the erythrocyte number was observed. This shows that there is a constant physiological difference between two races, independent of the environment.

A Fertile Species-Hybrid

GENETICISTS usually find that when two species are crossed, the offspring, if any, are sterile. Several garden plants have, however, originated as hybrids between two well-defined species, and now another plant has been found to have a similar origin. It is the pink-flowered chestnut, *Aesculus* × *Carnea*, recently described by Mr. M. B. Crane (*J. Roy. Hort. Soc.*, April 1935). Several well-authenticated instances of successful propagation of the hybrid from seed have been described in the garden literature of last century. Mr. Crane shows that each of the parents has twenty chromosomes, and upholds Skovsted's demonstration that *Aesculus Hippocastanum* has twenty small chromosomes in the germ cells, whilst *A. Pavia* has a similar number of large ones. The hybrid has forty, half of which are large, and the others small. Doubling seems to have been effected by autosyndesis—the non-reduction of both parental germ nuclei—since no parental types appear in the offspring. Several other species-hybrids are mentioned in the paper.

Effect of Rootstocks on the Nutrition of Apple Trees

MR. L. G. G. WARNE, of the University of Bristol, and Dr. T. Wallace, of Long Ashton Research Station, have investigated "The Composition of the Terminal Shoots and Fruits of Two Varieties of Apple in Relation to Rootstock Effects" (*J. Pomol. and Hort. Sci.*, 13, No. 1, pp. 1–31, March 1935). Several metabolic disturbances, such as leaf-scorch, have been observed in association with the use of certain types of rootstocks, and the paper under review shows that the various clones of stocks classified by Hatton at East Malling Research Station have certain well-marked effects upon the metabolism of the scion with which they are grafted. Malling stocks types II and V, known to be susceptible to potash deficiency, showed evidence of potash starvation even when that element was present in the soil in abundance. Rootstocks promoting great vigour in the scion produced a high ratio of potash to nitrogen

in the shoots, whilst a positive correlation was established between the ratio of phosphate to nitrogen in the wood, and precocity of bearing of the tree. The dwarfing effect of type IX could not be explained chemically. Many other results are set out in detail in the paper, and the chemical analyses have been correlated with extensive pomological records collected by Dr. T. Swarbrick and his colleagues.

Atmospheric Visibility

A DISCUSSION of the principles underlying the choice of the marks used in the estimation of atmospheric visibility, by W. E. Knowles Middleton, of the Meteorological Service of Canada (*Monthly Weather Review*, January 1935, p. 17), summarises very briefly the results of recent work in Germany and America on the measurement of the transparency of the atmosphere. This is a subject that has become more important in the last twenty years on account of the development of aviation, and is one which abounds in practical difficulties. It has long been known that the distance expressing the so-called 'visibility' of the atmosphere when determined by observation of the distance of the farthest of a selected group of objects such as trees, buildings, etc., is influenced by a number of factors unconnected with the state of the atmosphere, for example, by the excellence or otherwise of the observer's eyesight, and perhaps still more by the nature of the selected objects and the background against which they are seen. Mr. Knowles Middleton states that it is a common opinion that observations of this element made by the method just described are of no use in synoptic meteorology. He goes on to show that it is only when the objects used are black or nearly black and are seen against the sky that we are in effect measuring σ, the extinction coefficient of the atmosphere, defined by the equation $dE = -\sigma E dx$, where E is the flux density in a parallel beam of light travelling in the direction of x. His remedy is to use only black or nearly black objects against the horizon sky during the daytime, and never objects against terrestrial backgrounds, and to use interpolated values obtained from observations of such objects rather than misleading observations derived from an inspection of objects which appear against terrestrial backgrounds; and to have night observations made with the aid of some standard transmission meter, so that these may be independent of the local distribution of lights not set up specially for observations of visibility.

Solidification of Nitrogen and Argon

THE *Proceedings of the American Academy of Arts and Sciences* of March contains Prof. P. W. Bridgman's account of his determinations of the melting points of nitrogen and argon under pressures up to 6,000 atmospheres, their change of volume on, and latent heat of, fusion. The gas was contained in a chromium-nickel-steel cylinder closed by a gas-tight piston the movement of which gave the change of volume. The cylinder was surrounded by a liquid propane thermostat, the temperature of which was regulated by a hydrogen thermometer. The temperature of the gas was measured by a copper-constantan thermo-couple and its pressure by a manganin wire resistance gauge. The melting point of nitrogen rises from 63·3° K. at 1 atm. to 149° K. at 6,000 atm., the increase of volume on melting changes from 0·072 to 0·026 c.c. and the latent heat of melting from 218 to 346 kgm.-cm. per gram. For argon the figures are 83·9° K. to 193° K., 0·080 to 0·021 c.c. and 280 to 288 kgm.-cm. per gram. In each case, the change of melting point is nearly a linear function, and the increase of volume a hyperbolic function, of the pressure. The latent heat of fusion is in both cases nearly constant at pressures above 3,000 atmospheres.

Diffusion of Gases through Metals

C. J. SMITHELLS and C. E. Ransley (*Proc. Roy. Soc.*, A, May) have examined the diffusion of several gases through different metals, and thus obtained a more definite conception of the mechanism involved. The metal tubes were heated electrically and provision was made for analysing the gas which had passed through the tube walls. The dependence of the diffusion on pressure and temperature was investigated. The effect of temperature was satisfactorily represented by Richardson's exponential expression. Except at low pressure, the variation with pressure follows a $\sqrt{P}$ law, the diffusion probably taking place in the atomic state. According to the view of the authors, diffusion is always preceded by adsorption, and the deviation from the square root law may be explained by the use of the Langmuir isotherm. The diffusion is found to be strongly specific; nitrogen, for example, will diffuse freely through iron, chromium, or molybdenum, but not through copper, while no diffusion of argon or helium could be detected with any metal. This agrees with the view that activated adsorption is necessary for the diffusion.

Chemical Aspects of Biological Oxidation

IN his presidential address at the annual meeting of the Indian Chemical Society on January 4, Prof. N. R. Dhar discussed the chemical aspects of biological oxidations (*J. Indian Chem. Soc.*, 12, 96; 1935). Researches carried out in his laboratory have shown that organic substances, which are not directly oxidised by atmospheric oxygen at the ordinary temperature, can be oxidised by simply passing air through their solutions or suspensions when they are mixed with compounds which readily undergo oxidation in air, such as sodium sulphite, phosphorus, or freshly precipitated ferrous, cerous and manganous hydroxides. It has been found that proteins are more readily oxidised than carbohydrates, and carbohydrates than fats; in fact, the order is the same as was found by Voit in feeding experiments; with cerous hydroxide, as much as 83 per cent of egg white is oxidised, 57 per cent of starch and 30 per cent of butter. In all cases, the substance is oxidised completely to carbon dioxide and water. Prof. Dhar contrasted this process with the rapid oxidation of foodstuffs with hydrogen peroxide or a ferrous or ferric salt, in which intermediate compounds are formed, and compared the former with normal metabolic oxidations and the latter with the changes occurring in abnormal metabolism, such as the appearance of the 'acetone' bodies in diabetes or fasting, from the incomplete combustion of fats. In conclusion, he suggested that certain biologically active compounds, which are reducing agents, owe their activity to their power of inducing oxidations in other substances, and also directed attention to the effect of sunlight in inducing oxidations in the presence of air.

The National Physical Laboratory, Teddington

INSPECTION BY THE GENERAL BOARD

ON June 25, the General Board of the National Physical Laboratory made its annual inspection of the Laboratory. A large number of visitors were present, including members of scientific and technical institutions, Government departments and industrial organisations, and were received by Sir Frederick Gowland Hopkins, president of the Royal Society and chairman of the Board, the Right Hon. Lord Rayleigh, chairman of the Executive Committee, and the director of the Laboratory, Sir Joseph E. Petavel.

In the Physics Department of the Laboratory a number of problems connected with air conditioning of public buildings are being studied. Mention may be made of an examination of the water vapour absorptive properties of various classes of books, and of an investigation of the relationship between humidity and length for a number of hygroscopic substances, to ascertain their suitability for use in humidity-controlling apparatus. In the course of an investigation of the action of the wet and dry bulb hygrometer at low temperatures, a dew point apparatus has been developed for use as a standard of reference. In this, paraffin oil cooled by solid carbon dioxide circulates in a spiral path, attached to the back of a disc of chromium-plated silver, the temperature of which is measured by means of a thermo-element.

The apparatus devised for the determination of the ratio of the specific heats of carbon monoxide has been modified so that measurements of the velocity of sound can be made quickly at any one of several widely spaced frequencies. Electrically maintained quartz crystals are carried on a plate capable of rotation beneath the opening of a vertical furnace containing the gas under test. Each crystal gives a definite frequency so that the change of velocity with frequency can be determined at various temperatures of the gas.

For the measurement of the thermal conductivities of refractory materials, a test slab eighteen inches square and two inches thick is used. One face can be heated to 1,100° C., and the heat transmitted through the central area is determined by means of a water-flow calorimeter.

In the Radiology Division the relation between crystalline structure and the magnetic, electrical and tensile properties of materials is under investigation by X-ray diffraction methods, special attention being given to the detection and measurement of internal strain. This strain results in a broadening of the diffraction lines, and the degree of broadening can be used as a measure of the amount of strain present. New equipment has been added to the Division for the study of materials by electron diffraction methods.

The measurement of gamma-ray dosage in röntgens is under investigation and experiments have been made with both 'free-air' and 'air-wall' chambers, the latter having walls composed of materials of effectively the same atomic number as air. The effect of wall thickness on the ionisation produced in 'air-wall' chambers is being examined. A thick-walled chamber appears to indicate the dosage under conditions prevailing in deep-seated therapy, while a thin-walled chamber measures virtually the dose received at the surface.

In the Acoustics Laboratory considerable attention is being given to the problems of noise abatement and measurement. Investigations are being carried out on the sound-insulating properties against impact and air-borne noise of walls and floors of various designs. The use of absorbent materials in this connexion is being studied. For the measurement of noise, a portable acoustimeter has been developed in the Department. The instrument gives equal indications for notes of the same loudness, irrespective of pitch.

In the Optics Division a new type of colorimeter containing no rotating elements has been constructed. The light enters the mixing chamber through a condensing lens equipped with variable apertures containing the primary colour filters. Colour mixing is effected by the use of a small integrating sphere as a mixing chamber, the intensity of each primary stimulus being controlled by variation of the apertures.

In the Electric Standards Division of the Electricity Department consideration has been given to the construction of standard attenuators of calculable phase angle for the calibration of commercial attenuators at radio frequencies up to 1 mega-cycle per second. A combination of two of the laboratory residual inductance standards in the form of a potential divider can be used as an attenuator, and a number of units of this type have been constructed ranging in value from 1 decibel to 110 decibels.

An apparatus for the automatic comparison of frequencies by counting beats has been developed in the Division. The apparatus makes use of a system of relays which actuate, on one hand, a counter registering the number of beats produced by the two frequencies being compared, and, on the other hand, a counter registering seconds or fractions of a second down to one tenth of a second.

In the High Voltage Laboratory, oscillographic methods have been applied to the testing of lightning arresters. Experimental arrangements have been developed for determining the volt-ampere characteristics of arresters, the lag in their response to steep fronted overvoltages and their ability to interrupt the flow of current when the overvoltage has been disposed of. Records were shown illustrating the voltage acquired by a piece of apparatus with and without the arrester connected across it.

Research work is being carried out in the Electrotechnics Division of the Department on the alternating-current resistance of conductors for heavy currents. Formulæ have been developed for solid circular conductors giving close agreement with experimentally measured values. The problem of tubular conductors is now under examination.

An investigation is in progress in the Photometry Division to determine the illumination at which it becomes necessary to supplement daylight by

artificial light, and automatic means have been developed for recording this in the case of a number of selected office lights. A solenoid included in each office lighting circuit operates the shutter of a cine-camera when the light is switched on. Each exposure records the date, the time of day, which office light is switched on, and the reading of a calibrated ammeter and rectifier photo-cell unit. This reading determines the illumination in the office. In the same Division research is being undertaken to determine the change of sensitivity of the eye during recovery from exposure to high brightness backgrounds or to isolated bright sources of light. The work has applications to the problem of the recovery of eye sensitivity from the glare of motor-car headlights.

In the Radio Department an exhaustive examination of the factors responsible for departure from frequency stability has revealed the necessity for high thermal and secular stability on the part of the inductance and capacitance. An inductance coil and variable condenser possessing extremely low temperature coefficients were exhibited; in these, use is made of differential expansion systems.

Attention has been given to the use of inverted diodes, split-anode triodes and magnetron oscillators as generators of very high-frequency oscillations. A demonstration was given of the generation, by a four segment magnetron, of ultra-short waves in a Lecher-wire system connected to the segments of the anode.

In the course of research on direction finding, a potentiometer method has been developed for the excitation of a rotating radio-beacon. The method utilises a dual potentiometer connecting an oscillator to two amplifiers which feed two pairs of aerials arranged at right-angles. The motion of the potentiometer contacts is such that the voltages applied to the two amplifiers vary sinusoidally and in opposite phases, producing a rotating field in the aerial system.

In an investigation into the nature and origin of atmospherics, oscillographic records have enabled the wave form and direction of individual atmospherics to be determined. Simultaneous records obtained at two different stations permit the place of origin of the atmospheric to be ascertained. Results obtained have shown that the recorded wave form of an atmospheric depends on the distance of the source producing the disturbance.

In the Metrology Department the standard leading screw lathe used for the correction of the pitches of lead screws has been entirely reconstructed. The traverse has now been extended to five feet and, by the introduction of change gears, screws having any English or metric right-handed pitches can be dealt with. Calibration of the reconstructed lathe has shown that its cumulative pitch is correct to within 0·0003 inch throughout its traverse.

New apparatus has been constructed for the direct testing of mercurial barometers at pressures varying from 2 in. to 34 in. of mercury, the pressure being accurately controlled by a specially designed barostat. The apparatus can accommodate five barometers for test in addition to the standard mercury barometer. A standard barometer has been constructed combining the principles of the Fortin, Newman and Kew barometers, so that instruments of all three types can be tested directly in the new apparatus.

The study of fatigue in relation to crystal structure has been continued in the Engineering Department and the effect of crystal orientation on fatigue strength is being examined for a number of single crystals of aluminium. Attention is also being given to the effect of intercrystalline boundaries on fatigue failure and tests are being made on specimens consisting of several crystals of aluminium. Specimens and results illustrating these two phases of the work were exhibited. For the determination of the fatigue strength of materials under combined alternating stresses, high-speed machines, in which different combinations of plane bending and torsion can be applied, have been constructed. Various plain and alloy steels and cast crankshaft materials are under examination.

Investigation is being made into the industrial applications of air injectors with reference to their use in maintaining air streams laden with granular matter. An experimental pneumatic conveyor has been constructed and experiments are being carried out to determine its performance.

The Department is investigating the principles underlying the design of satisfactory pipe-line joints capable of withstanding high temperatures and pressures. The work entails the study of the behaviour of flanged joints under pressure at air temperature, and at high temperatures, and measurements of bolt creep. The equipment permits tests to be made on 8-in. pipe flanges at temperatures up to 1,000° F. and at steam pressures up to 1,400 lb. per sq. inch.

A number of lubrication problems are receiving attention. Mention may be made of research on the aspect angle and attitude of a journal bearing under varying load, speed, clearance and temperature, and experiments on the effect of running in a clearance bearing at the seizing temperature of oils. Sensitive apparatus has been developed for measurement of the profile of bushes to determine the change of shape caused by running.

In the Metallurgy Department the production of iron of a high degree of purity has been achieved by the direct reduction of pure iron oxide in hydrogen. Specimens with a purity of the order of 99·99 per cent and of great softness and ductility were exhibited.

In view of the importance of oxide surface films in connexion with the problem of removing gases from molten metals, a systematic examination of the structure of such films is in progress by means of electron beam diffraction methods. The work has been extended to the study of oxide films formed on solid metals and alloys under atmospheric conditions and at high temperatures.

Considerable work is being carried out on the production of magnesium alloys, with the view of developing alloys stronger than those at present available for use at ordinary and at elevated temperatures. The microstructure, constitution and rolling and mechanical properties of various magnesium alloys are being investigated. The difficulty experienced in rolling and forging many of these alloys has been largely surmounted by slow pressing at high temperatures. A new experimental slow-speed rolling mill has been installed for use in breaking down the cast ingots.

In the Aerodynamics Department problems relating to the landing and take-off of aircraft are receiving attention. The work is of a two-fold character. The effect of landing flaps on stability near stalling incidence is being examined by means of the rolling balance. Measurements are made of the tendency of various wing sections, fitted with flaps and mounted on the balance, to accelerate or diminish rolling motion. The effect of proximity to the ground on the forces acting on an aeroplane is

also under investigation. Systematic measurements are made of the lift, drag and pitching moment of models at various distances from the ground.

Research is being carried out on the effects of gusts on the stresses in aircraft, and apparatus has been designed for recording the changes in vertical wind velocity in a gust. The use of this apparatus in conjunction with a recording anemometer measuring the mean horizontal wind speed, gives sufficient information to permit the effect of the gust to be predicted.

The performance of a number of high-pitch airscrews covering a wide range of pitch/diameter ratio has been measured and the results have been correlated with modern airscrew theory. Examination is now being made, by means of the hot spot method of flow photography, of the periodic flow through such airscrews, with the view of obtaining a direct experimental check of the basic assumptions of theory.

In the William Froude Laboratory, the effect of waves on ship resistance and propulsive efficiency together with the influence of hull form on this problem is under investigation. Demonstrations were given with a self-propelled model of a high-speed, twin-screw vessel. The speed, the propeller thrust, the amount of pitching and heaving, and the power required to drive the model are automatically recorded during its passage through rough water.

A number of model propellers made of a special aluminium alloy developed in the William Froude Laboratory were exhibited, together with apparatus for conducting tests with model propellers in open water.

The British Waterworks Association

ANNUAL MEETING

THE annual meeting of the British Waterworks Association at Cambridge on June 26 was the occasion for a vigorous and outspoken presidential address by Prof. C. E. Inglis, who, after a brief but interesting account of the origin and early development of the University, reviewed the policy of successive Governments in the past in respect of water supply for the needs of the country, and made some caustic comments on the "futile process of appointing water Commissions and pigeon-holing their reports" which has been its chief characteristic. He added that he regretted to observe the reappearance of the "policy of procrastination which has blighted waterworks legislation for the past 60 years" in the recent announcement by the Minister of Health in the House of Commons that as a preliminary to water legislation of a general character, a Joint Committee of the House of Lords and the House of Commons was to be set up to report "on measures for the better conservation and organisation of water resources and supplies in England and Wales".

Four papers presented to the Conference were more or less technical in character. One on "Water Softening at Cambridge", jointly written by Dr. Suckling and Mr. Philip Porteous, described the particular nature of the water at Cambridge, and the method of softening adopted after full consideration of the relevant data. The Cambridge water, which is derived from the Chalk, a formation which outcrops in the southern half of the county, is stated to be "uniformly clear, bright and colourless" containing no iron or manganese in solution. "The total solids, magnesium content and permanent hardness are not unduly high and sodium salts are only sparingly present. The water is neutral in reaction, the content of carbonic acid is low and no corrosive tendency has been exhibited during many years of use." It is also of excellent organic and bacterial purity. Being convinced on these grounds that the desired degree of softening could be satisfactorily attained by either the lime or the base-exchange process, the final decision of the local water company in favour of the latter was made on the basis of financial and engineering considerations. Tabular analyses are given of the water before and after softening, the total hardness of the untreated water being 24·0 (temporary hardness, 17·5; permanent hardness, 6·5). After treatment and blending, the total hardness (entirely temporary) is 11·5. The softened water sent into supply is described as "clear, bright, colourless, odourless and palatable". The water-softening plant consists of six units, each of 9 ft. diameter, capable of delivering "zero hardness" water continuously at the rate of 16,000 gal. per hour for 10 hours, after which it is put out of commission for regeneration. Each cylinder contains about 10 tons (420 cu. ft.) of Doucil, a synthetic zeolite, and is supported on a 12-in. bed of graded gravel. The synthetic zeolite was chosen in comparison with natural zeolite on financial and engineering grounds as in the case of the process. The salt consumption for regeneration is guaranteed not to exceed a rate 5,600 lb. per million gallons of water softened to zero hardness.

The paper by Mr. Philip Ulyott on "Biological Research in Relation to Water Supply" was a brief statement of the results of modern investigation in the subject, and of the sequence of events connected with plant life in an aqueous environment. A lengthy paper, full of interest from the historical and engineering point of view, was contributed by Mr. H. C. Darby on "Windmill Drainage in the Bedford Level" in the southern part of the Fens. Writing in 1748, Thomas Neale states that "there are now no less than two hundred and fifty [windmills] in the Middle Level. In Whittlesey parish alone I was told by some of the principal inhabitants there are more than fifty mills and there are, I believe, as many in Donnington with its members. I myself, riding very lately from Ramsey to Holme, about six miles across the Fens, counted forty in my view." But, as Mr. Darby points out, the windmill was a "wayward co-operator at the mercy of wind and gale and frost and calm. It was never powerful and it never provided a satisfactory solution to the problem of clearing water from the drains." Finally, there was a paper of a financial and administrative character by Mr. T. G. Rose on "Modern Methods of Management Control".

Petroleum Industry of France

MR. VICTOR FORBIN'S recent article on the French petroleum industry (*La Nature*, No. 2952, 385–396, May 1, 1935) is in effect an unanswerable vindication of France's claim to recognition as a petroleum power in the world to-day. Admittedly, at the beginning of this century and during the great development of the world petroleum industry, actuated by invention and universal adoption of the internal combustion engine, France had little right to recognition, for at this time tariff protection had been withdrawn and she was only able to supply 10 per cent of her domestic requirements of petroleum and products. This position was more or less maintained until 1925, when l'Office National des Combustibles Liquides was founded to give expression to the French desire "de devenir une puissance pétrolière". Close co-operation between this body and the Government led to drastic reorganisation of the entire industry and finally, in 1928, to the passing of a law which is now regarded as the charter of the French petroleum industry.

Under the new regime initiated by this law, authorisations were granted for importation and refining of crude petroleum in France for periods up to twenty years. Eleven industrial concerns contributed capital amounting to nearly 3,000 million francs for the erection of refineries at suitable places along the coast. Thus France acquired at Le Havre, at the mouths of the Rivers Loire, Gironde and Rhône, etc., some of, perhaps, the most modern refineries in the world. Systematic co-operation within the industry and far-seeing dispensation of resources led to the optimum equipment of each refinery for some particular type of raw material. Some are capable of producing the whole range of petroleum products, while others confine their activities to production of petrol, kerosene, gas-oil, etc.; throughout the industry there is a wholehearted spirit of co-operation and a common desire that France should have a petroleum industry comparable with that of other nations.

France is now definitely reaping the benefit of this far-sighted policy initiated some five years ago, for when the first consignment of Iraq oil was conveyed by the pipe line to Tripoli in August 1934, there were new tank-ships ready for its conveyance to Le Havre and everything was in readiness for its reception. During the last five months of 1934, after completion of both branches of the Iraq pipe line, 600,000 tons of crude oil were exported from the twin ports of Tripoli and Haifa, 520,000 tons of which were destined for France. In 1934 French refineries treated 3¼ million tons of raw material, and it is estimated that this quantity will be increased to 4 million tons in 1935, as compared with 1,034,819 tons in 1932 and 2,739,305 tons in 1933.

During the first eight months of 1934, France exported 28,647 tons of kerosene and 682,292 tons of gasoline to Great Britain, Switzerland, Italy and other countries. These facts and figures should confute those who are still under the impression that the French petroleum industry is directed by foreigners.

Pollination Mechanism in Conifers

PROF. JOSEPH DOYLE and Miss Mary O'Leary have published (*Sci. Proc. Roy. Dublin Soc.*, 21, N.S., Nos. 19, 20 and 21, February 1935) a series of papers upon the pollination mechanisms in conifers. Their researches include records of intensive observations in the field, which are interpreted most interestingly in the light of the wide knowledge of the senior author of the comparative morphology of the reproductive structures in the group.

The authors point out that our knowledge of the movement of pollen on to the nucellus in *Pinus* has so far rested upon second-hand statements, most of them derived from some incidental observations by Strasburger. Strasburger appears to have assumed, on the basis of other well-known cases, that a fertilisation drop was formed and, in view of their turgid transparent appearance, to have ascribed its formation to the two characteristic prolongations of the integument beyond the micropyle.

As the result of very patient investigation, the Irish observers have at last seen this fertilisation drop—but at 2 a.m. in the morning—and by 7.30 a.m. every ovule is dry! This secretion appears to come from the nucellus, and though at night it may be found in almost every mature unfertilised ovule as it wells out of the micropyle and part of the way along the micropylar projection, it usually soon picks up some pollen grains from these arms. When these are immersed in the fluid, in the inverted ovule, they rapidly float with their winged surface uppermost on to the nucellus; the grain is thus brought against the nucellus with the surface towards it through which the pollen tube emerges. More remarkable still, within ten minutes of the grain being thus transferred to the nucellus, the drop is once more reabsorbed while it still remains in the unpollinated ovule. The authors have tested this by introducing pollen into the drop at night. They argue cogently that the function thus suggested for the winged expansions to the pollen grain is much more reasonable than its use for transport of the grains in the air, as the larger grains of *Larix* and *Pseudotsuga* are without wings.

On the other hand, the authors have to solve the problem how these wingless pollen grains of *Larix* also reach the surface of an inverted ovule. In *Saxegothæa* and *Cedrus* they describe the germination of pollen grains well away from the micropyle and their growth to the nucellus: they also figure and discuss the function of the stigma-like projections in the integuments of *Pseudotsuga* and *Larix*. These papers are full of stimulating discussion of new data that are a permanent contribution to our knowledge of the pollination mechanisms of the conifer.

Educational Topics and Events

EDINBURGH.—At the graduation ceremony on June 28, the honorary degree of LL.D. was conferred on the following: The Right Hon. the Viscount Bledisloe, Governor-General and Commander-in-Chief of New Zealand; Dr. J. L. Garvin, editor of the *Observer*; Dame Maria M. Ogilvie Gordon, geologist and vice-president of the International Council of Women; Prof. J. Graham Kerr, M.P., regius professor of zoology in the University of Glasgow; Prof. John Laird, regius professor of moral philosophy in the University of Aberdeen; Sir George Macdonald, formerly secretary of the Scottish Education Department, archæologist, numismatist and historian; Dr. J. D. Pollock, Hon. Surgeon-Commander, R.N.V.R.; The Hon. Lord St. Vigeans, formerly chairman of the Scottish Land Court.

The degree of D.Sc. was conferred on the following, for the theses indicated: A. B. D. Cassie ("Infra-Red Absorption Spectra and Molecular Structure of Triatomic Molecules"); D. Clouston ("The Identification of Grasses by Leaf Anatomy"); Dr. J. MacLeod ("The Ecological Complex controlling Activities and Distribution of *Ixodes ricinus*"); Dr. H. W. Melville ("The Kinetics of Gaseous Chain Reactions").

OXFORD.—Sir Charles Sherrington has resigned the Waynflete chair of physiology, which he has held since 1913, as from October 1.

Mr. L. S. Bosanquet has been granted the degree of D.Sc.

At Christ Church, Mr. D. Roaf has been elected to the Duke of Westminster research studentship (that is, fellowship) for work in nuclear physics, and Mr. J. A. Moy Thomas to a lectureship for research in vertebrate palæontology.

At the Queen's College, Mr. E. W. Yemm has been elected to a junior research fellowship in botany.

DR. JOHN A. WHEELER has been appointed assistant professor of physics in the University of North Carolina, at Chapel Hill. During the past year, Dr. Wheeler has pursued research in nuclear physics at the Institute of Theoretical Physics in Copenhagen.

GERMAN universities are, one gathers, like other cultural institutions in Germany, being remoulded so as to conform with Nazi aims. A letter from the Berlin correspondent of the American Medical Association tells of a new decree releasing the general student body from obligatory attendance on the special political training course prescribed, together with enrolment in a hostel, for members of the Nazi student league. The director of this league has announced that "during the past year and a half the student has been tossed about to such an extent that he has lost most of his faith in attempts to direct the thinking of students. A reawakening of this faith I regard as a necessity . . ." Last winter new regulations made compulsory for all students participation in physical exercises and sports, including *fünfkampf* training and rifle exercise during the first three semesters as a pre-requisite for any degree. Another interesting development is the provision made for permitting twenty of the most talented sons of workmen to attend a university without presenting a diploma of completion of a secondary school course. For such special entry the Universities of Heidelberg and Konigsberg are being considered.

SEX education in schools is discussed in a remarkable paper by Dr. E. P. Phillips which has been published by the Transvaal Education Department in its monthly circular for April. Dr. Phillips writes as a biologist. He begins by emphasising the fact that notwithstanding the fundamental biological discoveries of the past seventy-five years, we still think in terms handed down to us by earlier civilisations, terms involving an often inextricable entanglement of religious ideas with ideas relating to sex. Hence arise divergences between mental outlooks which he classifies as the orthodox religious, the biologist's, and that of the large body of parents who, while not holding very strict religious views, are ignorant of the elements of biology. There should, he holds, be no course of sex education *as a subject*, taught either by the school staff or by visiting doctors; but all children should receive instruction, which should begin before the age of puberty, in some of the more important biological facts about themselves as human beings. It should be inculcated that mankind is faced, like myriads of other species, with the two fundamental problems—the struggle for individual existence and the struggle to maintain the species. Thereafter, the similarity of mankind to the rest of the animal kingdom having been sufficiently demonstrated, the overwhelming importance of the reasoning faculty which differentiates the human from other species should be stressed in connexion with man's social development. To adolescents who have received such a grounding, information about the dangers and implications of sex can be imparted without difficulty. The crux of the scheme for such a broad biological course is the supply of suitable teachers. These should have studied biology, chemistry, physics and geology, should have read widely, and should have tact, sympathy and understanding. The course should not be taught as an examination subject, thereby suppressing the individuality of the teacher. It should be a necessary part of every child's social, moral, ethical and religious training.

Science News a Century Ago

Lyell and Sir John Herschel

LYELL, whose "Principles of Geology" had been published originally in three volumes in 1830, 1832 and 1833 respectively and had been republished in four volumes in 1834, wrote to Sir John Herschel on July 6, 1835: "I heard some months ago from Whewell that you had, in one of your letters to him, expressed much pleasure at some parts of my book, which I think you read when on your way to the Cape. It has been so much altered, enlarged, illustrated, abridged, and I hope improved since the first edition, that I am anxious, if you ever refer to it again, that you should see it in its amended state. Some of my friends have read letters of yours which they have received, to me, and I rejoice that your grand scheme of visiting the Southern Hemisphere has answered so well."

"When at Copenhagen last year Oersted, who was reading your paper on double stars, was talking of

it continually, and trying to make me understand the *poetry* of some speculations, which only amused me, from seeing that it was deep mathematics with which he was delighted, as with a romance."

"Murray has sold 1,750 copies of my book in the last ten months, so that I have the satisfaction of being much read. . . ."

The Science of Education

AN advertisement in *The Times* for July 6, 1835, ran as follows: "A Course of Seven Lectures on the Science of Education will be delivered in Willis's great Rooms, 26 King-street, St. James's, commencing tomorrow the 7th of July at 3 o'clock, and continued on Tuesdays, Thursdays and Saturdays at the same hour, by the Rev. R. J. Bryce, LL.D., Principal of the Belfast Academy. The object of these lectures is to reduce the art of teaching and managing children to scientific principles, derived from the known laws of the human mind; to point out the best methods in each department of education; and to show the means of varying those methods to correspond with the endless varieties which occur in the minds of children. The formation of such a science of education has been spoken of as a great desideratum by the most eminent philosophers of modern times, and has long been anxiously wished for by the most distinguished friends of education. . . . The proceeds of the lectures, after paying necessary expenses, will be placed at the disposal of a committee of the audience, to be by them applied to the promotion of some object connected with the improvement of education."

J. D. Forbes in the Pyrenees

THE travels of Prof. J. D. Forbes began when, as a boy of sixteen years of age, he visited France, Germany and Italy. This journey led to the publication of his first scientific memoir, "Remarks on Mount Vesuvius", which appeared anonymously in the *Edinburgh Journal of Science*. Six years later, in 1832, he first visited Switzerland, from which he hastened home to enter successfully for the chair of natural philosophy at Edinburgh. His favourite subject was heat, and in the summer of 1835 he set out to study the hot springs of the Pyrenean valleys. His letters and journal contain many interesting observations on his travels. On July 7, 1835, he went from Bordeaux to Pau by diligence and on July 9 he records: "A splendid morning. . . . The whole range of the Hautes Pyrenées was now uncovered, and presented as noble and rugged an outline as I ever saw. . . ." He then went to Eaux-Bonnes and to Eaux-Chaudes with its splendid gorge. "If ever there was a valley of disruption," he wrote, "it is this one, though I do not pretend always to decide. This confirms Dr. Daubeny's theory of hot springs, especially as these waters issue just at the junction of the granite and limestone. The limestone rises always to the granite, more as it approaches it, and at last is elevated in horizontal strata on the top of it—at least so far as I can judge from a very imperfect examination. What confirms the view of the granite being the upheaving agent is that the valley of disruption is perpendicular in direction to the strata (Hopkins' theory). It is remarkable that there are signs of water wearing (obviously not weathering) on the rocks at a great height above the torrent."

Societies and Academies

LONDON

Royal Society, June 27. W. A. BONE, R. P. FRASER, and W. H. WHEELER: A photographic investigation of flame movement in gaseous explosions. A new view of the detonation wave in gaseous explosions is advanced. It can no longer be regarded as simply a homogeneous shock wave in which an abrupt change in pressure in the vicinity of the wave-front is maintained by the adiabatic combustion of the explosive medium through which it is propagated, but it must now be viewed as a more or less stable association, or coalescence, of two separate and separable components, namely, of an intensively radiating flame-front, with an invisible shock wave immediately ahead of it. According to the new view, detonation in an explosive gaseous medium is the propagation through it, as a wave, of a condition of intensive combustion, initiated and maintained in a shock wave by radiation from an associated flame-front; and spin ensues whenever the conditions are such that the radiation from an attenuated flame-front causes a localised intensive excitation of molecules in the shock wave just ahead of it. The experimental part of the work has been mainly concerned with detonations in a moist $2CO+O_2$ medium, which has proved to be specially adapted to the elucidation of the dual character of the phenomenon. O. H. LATTER and H. ELTRINGHAM: The epigamic behaviour of *Euploea* (*crastia*) *core asela*, Moore (Lepidoptera, Danainæ) with a description of the structure of the scent organs. Observations in the field show that the male butterfly diffuses, from brushes exserted from the abdomen, a scent which attracts females from a distance. While male scent organs of great complexity are found in many insects, no evidence has previously been obtained of the distant action of such organs, termed here 'telegamic'. B. F. J. SCHONLAND, D. J. MALAN, and H. COLLENS: Progressive lightning (2). A general account, based on the study of 95 flashes photographed with the Boys and other cameras, is given of the mode of development of the lightning discharge. It is shown that the leader-return stroke sequence is present in almost all the cases examined. Leaders to first strokes are stepped, those to subsequent strokes generally dart-like. In certain cases of very slow dart leaders, these change to the stepped form at their lower ends. Slower leader velocities and higher intensities of return strokes are associated with longer time-intervals between strokes and their predecessors; hence the degree of pre-existing ionisation in the channel governs the velocity of the dart-leader. The downward-branching of lightning and its characteristic zig-zag form arise during the stepped leader process before the first return stroke.

PARIS

Academy of Sciences, May 20 (*C.R.*, 200, 1697–1804). CHARLES ACHARD and AUGUSTIN BOUTARIC: The physicochemical study of the changes undergone by the blood serum under the influence of heat. The diluted serum is treated with charcoal, and the quantity of the latter determined which completely removes the colloidal substances, use being made of the surface tension. Data are given for results obtained by heating for various times at temperatures between 55° C. and 62° C. PIERRE WEISS: The

equation of state of fluids. The negative internal pressure at high temperatures. CHARLES NICOLLE and MME. HÉLÈNE SPARROW: Infection by the conjunctiva of small apes with the murin I typhus virus from Tunisian rats. JEAN MIRGUET: The continuity of the biparatingent. PAUL ALEXANDROFF: Suites of topological spaces. ADOLPHE BUHL: The integral of Stieltjes. LADISLAS FEJES: Cauchy's exponential series. N. GÜNTHER: The resolvant of certain integral Hermite equations. A. KOLMOGOROFF: The Laplace transformation in linear spaces. JEAN BRAÏTZEFF: The fundamental formula of the theory of Dirichlet's series. FLORIN VASILESCO: Remarks on the various methods of solution of the problem of Dirichlet. PAUL LÉVY: A tensorial form of the functional differential equations of Green's and Neumann's functions. LÉON BRILLOUIN: The transversal physical waves in wave mechanics and the harmonic oscillator in four dimensions. PAUL BERNARD: The measurement of the pressures developed by explosive substances. A comparison of crusher pressures with true pressures measured by a piezoelectric dynamometer. The results with a light and heavy piston in the crusher manometer are compared graphically. DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The interpretation of the continuous absorption of hydrogen in stars of early spectral types. AUREL POTOP: The thermal conductivity of metals examined in the form of small bars. JACQUES VAN MIEGHEM: The velocity of transport of electromagnetic energy. CHARLES BÉCHARD: The electrolytic deposit of alloys of copper and tin. PIERRE SÜE: The conductivity and hydrolysis of the sodium niobates. The orthoniobate is completely hydrolysed: the salt, $7/6\ Na_2O$, Nb_2O_5, is strongly hydrolysed and in equilibrium with the metaniobate. AURELIAN NAHERNIAC: The study of a characteristic band of the OH group in the near infra-red. MME. LUCIE LEFEBVRE: The absorption spectrum of ozone in the region of the photographic infra-red. The tubes employed were equivalent to a column of 50 cm. of pure ozone: the region explored was between 6500 A. and 10,000 A. EMILE SEVIN: The play of waves, spin and numbers. PIERRE AUGER, LOUIS LEPRINCE-RINGUET and PAUL EHRENFEST: The absorption of the soft fraction of the cosmic corpuscular radiation. An account of results obtained at the International Laboratory at the Jungfraujoch. FRANCIS PERRIN: The mechanism of the capture of slow neutrons by light nuclei. MME. L. S. MATHIEU-LÉVY: The influence of complex formation on the adsorption of copper in ammoniacal solutions by precipitated ferric hydroxide. MLLE. M. QUINTIN: The application of Debye's theory to solutions of cadmium chloride. CHARLES TOURNEUR: Study of the action exercised by alcohol on gum arabic sols, as shown by the polarisation of the diffused light. ARAKEL TCHAKIRIAN and HENRI VOLKRINGER: The Raman spectra of the bromine compounds of germanium and of tin. Comparative diagrams are given of the Raman spectra of the compounds RBr_4 and $RHBr_3$, where R is carbon, silicon, germanium or tin. AUGUSTIN MACHÉ: Contribution to the study of the determination of ozone. Comparisons of the iodide and fluorescin methods. For low concentrations of ozone the latter is more accurate. A. P. ROLLET: The potassium borates. Study of the system B_2O_3, K_2O. MAURICE BILLY and PAUL BRASSEUR: The preparation of anhydrous titanium trichloride. The tetrachloride is reduced with precipitated antimony, afterwards removing the excess of tetrachloride with carbon tetrachloride and the antimony chloride with anhydrous ether. PIERRE CARRÉ and HENRI PASSEDOUET: The relative mobilities of the normal primary alkyl groups from C_1 to C_{16} in their chloroformates. G. MULLER: The oxidation of mineral oils by gaseous oxygen at moderate temperatures. The chemical nature of the oxidation of mineral oils is the same whatever their origin or previous treatment, although the amount of deposit may vary considerably. The white refined oils are most strongly oxidised. ALEXANDRE DINCA-SAMURACAS: The polarisation of seismic waves in the primary phase of earthquakes. LOUIS FAGE: The localisation in the intermediate waters of the Pacific of the little-known *Ceratolepis hamata*. A single specimen of this organism was collected by the *Challenger* between the New Hebrides and Australia. During the last voyage of the *Dana* in the Pacific, Schmidt was able to collect nearly two hundred specimens of this Crustacean. The results obtained from this material are given, completing the description given by Sars of the *Challenger* specimen. M. BURGAUD: Magnetic observations in the south and south-west of China and a map of the isogonics and isodynamic lines. LOUIS EMBERGER: New botanical researches in the eastern Grand Atlas. JEAN CHAZE and ANDRÉ SARAZIN: The parasitism of mushroom beds by the mole is a reversible phenomenon. ARMAND DEHORNE: The anatomical and cytological characters of the thoracic nephridia of *Sabellaria*. PAUL MATHIAS: The evolutive cycle of a holostomid trematode, *Cyathocotyle Gravieri*. OCTAVE DUBOSCQ and MLLE. ODETTE TUZET: A new stage of development of the calcareous sponges. GEORGES UNGAR and MLLE. MARIE ROSE ZERLING: The intervention of a humoral transmission in vasodilatation known as antidromic. Arguments in favour of the existence of histaminergic nerves. MME. VÉRA DANTCHAKOFF: The equivalence of the somatic tissues in the gonads of the fowl. PIERRE GRABAR and ANDRÉ RIEGERT: The nature of urease: approach to the study with the aid of fractional ultra-filtration. The activity of urease is intimately connected with very bulky molecules of protein nature: Sumner's crystallised urease, in aqueous solution, was the most homogeneous of the preparations studied. AUGUSTE and RENÉ SARTORY, JACQUES MEYER and FRÉDÉRIC ARNOLD: Comparative attempts at the determination of the phosphorus and potassium contained in an arable soil by means of Hilgard's chemical method. Neubauer's biological method and that of Niklas, utilising *Sterigmatocystis nigra*. The Niklas method is very suitable for determining the immediate requirements of a soil. CONSTANTIN LEVADITI and JEAN VIEUCHANGE: The inoculability of certain neurotrope viruses (herpes, poliomyelitis) through the external auditory canal.

VIENNA

Academy of Sciences, May 9. F. WESSELY, K. DINJASKI, W. ISEMAN and G. SINGER: Bitter principles of kolombo root—kolumbin. G. KIRSCH: Viscosity and melting curves. E. HASCHEK and H. MACHE: Dependency of spark-noise on the electrode material with a rapid succession of sparks. E. CHWALLA: Bulging of rhomboidal plates under pressure and shear loading. W. PASSER: Pressure distribution through an elastic layer. W. W. LEPESCHKIN: Fundamental substances of living matter (vitaids) and their significance in biology.

The importance of 'vitaids' to life is probably due to the part they play in the structure of the consistent phase of the protoplasm. F. ROCH and F. MOLL: New terenid species. F. HERITSCH: Uppermost lower Devonian and lower mid-Devonian. A. THURNER: Position of the Trias in the mountains around Murau. O. GUGENBERGER: The Cardita layers of Launsdorf in mid-Carinthia and their fauna. H. REBEL: Lepidoptera from the Ægean Islands. F. WERNER *et al.*: Insects and arachnoids of the Ægean Islands. L. FLAMM: Algebraic electrodynamics. A. SKRABAL: Chemical induction. In continuation of investigations on the kinetics of intermediate reactions, those general systems are considered which can be decomposed into separate systems with different total reactions. M. PESTEMER and L. WILIGUT: Ultra-violet absorption of certain aromatic hydrocarbons (3); constitution of tetrahydrodiphenyl. Substances with double linkings conjugated to the benzene nucleus show a marked increase in the extinction, whereas the extinction of the benzene bands is not increased by substitution with alkylenes or olefines in which the double linking is separated from the benzene nucleus by more than one carbon atom. From this it follows that the tetrahydrodiphenyl obtained by hydrogenation of diphenyl has the constitution of the known 1-phenylhexene-1. E. ABEL and J. PROISL: Mechanism of the lead-chamber reaction (1); reaction between sulphurous and nitrous acids in the dilute system. A. PONGRATZ and G. MARKGRAF: Perylene and its derivatives (44). A. VERDINO and E. SCHADENDORFF: Condensations of ethyl chlorocarboxychlorate with amines and phenols. W. KOSMATH: Process for measuring the momentary radon content of the open air at spas with radioactive waters. Use is made of the arrangement previously described, which consists essentially of two similar cylindrical air-tight ionisation chambers (measuring chamber and compensation chamber) of about 9 litres capacity, and a Lindemann electrometer with switch-box. T. KORMOS: Revision of the small mammal remains of Hundsheim. A. WAGNER: Daily course of cosmic ultra-radiation. A reply is made to Hess's criticisms of the author's previous communication. A. FINK, P. GROSS and H. STEINER: Conductivity of strong acids in mixtures of heavy and light water. Determinations have been made of the conductivities of hydrochloric and perchloric acids in about 0·01 *N* solutions in mixtures of heavy and light water at 18° C. The value of the equivalent conductivity of hydrochloric acid at infinite dilution falls from 377 to 250 in pure deuterium oxide, the fall being non-linear. K. UNNA and L. WALTERSKIRCHEN: Action of anti-diuretic pituitary hormone on dogs to which water is or is not given.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, July 7

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J. Edwards: "The World 50,000,000 years ago, 150,000,000 years ago and 1,000,000,000 years ago".*

INSTITUTE OF CHEMISTRY, July 9–10.—Charter Jubilee Celebrations, to be held in London.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Vol. 55, Part 1, No. 5: The Mathematical Representation of the Energy Levels of the Secondary Spectrum of Hydrogen, 2. By Dr Ian Sandeman. Pp. 49–61. 1*s*. Vol. 55, Part 1, No. 6: The New Crystallography. By Prof. W. L. Bragg. Pp. 62–71. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The British Science Guild. Gas Defence. By J. Davidson Pratt. Pp. 18. (London: British Science Guild.) 1*s*.

True Temperance Scientific Committee. Monograph No. 1: The Problem of the Intoxicated Motor Driver. Pp. 15. (London: True Temperance Scientific Committee.) 2*d*.

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1934–1935. Pp. 14. (Birmingham.)

Empire Cotton Growing Corporation. Report of the Fourteenth Annual General Meeting. Pp. 8. (London: Empire Cotton Growing Corporation.)

Financial and Economic Position of Basutoland: Report of the Commission appointed by the Secretary of State for Dominions Affairs. (Cmd. 4907.) Pp. viii+225. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1649 (S. 163, 195, 211, 221): Wall Interference and Depth Effect in the R.A.E. Seaplane Tank and Scale Effect Tests on Hulls of Three Sizes. By L. P. Coombes, W. G. A. Perring, D. W. Bottle and L. Johnston. Pp. 30+35 plates. (London: H.M. Stationery Office.) 3*s*. net.

British Non-Ferrous Metals Research Association. Supplement to Research Monograph No. 2: Bibliography of Literature on Spectrum Analysis. Compiled by D. M. Smith. Pp. 20. (London: British Non-Ferrous Metals Research Association.) 1*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 24: A Simple Titrametric Method for the Approximate Determination of Milk Phosphates. By G. T. Pyne. Pp. 223–229. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1934. Pp. viii+456+66+11 plates. (London: H.M. Stationery Office.) 12*s*. 6*d*. net.

London Shellac Research Bureau. Technical Paper No. 2: Identification and Analysis of Lac. By Dr. R. Bhattacharya. Pp. 28. (London: London Shellac Research Bureau.)

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd. Twentieth Annual Report, 1934. Pp. 107. (Cheshunt: Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd.)

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1934. Pp. 52. (London: H.M. Stationery Office.) 1*s*. net.

Other Countries

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 15. La perforación astragaliana y el credo. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 730+40 plates. (La Plata.)

U.S. Department of Agriculture. Circular No. 346: Insect Parasites and Predators of Insect Pests. By Curtis P. Clausen. Pp. 22. (Washington, D.C.: Government Printing Office.) 5 cents.

Chemical Industry's Contribution to the Nation, 1635–1935: a Record of Chemical Accomplishment, with an Index of the Chemicals made in America. A Supplement to *Chemical Industries*, May 1935, published in celebration of the Tercentenary of the founding of the American Chemical Industry by John Winthrop, Jr. Pp. 176. (New York: *Chemical Industries*.) Paper, 1 dollar; cloth, 2 dollars.

Annuario della Reale Accademia d'Italia. 6: 1933–1934. Pp. 383+4 plates. (Roma: Reale Accademia d'Italia.) 25 lire.

Imperial College of Tropical Agriculture. Fourth Annual Report on Cacao Research, 1934. Pp. 87+4 plates. (Trinidad: Government Printer.) 5*s*.

Report on the Administration of the Government Museum and Public Gardens, Trivandrum, for the Year 1109 M.E. Pp. 13. (Trivandrum: Government Museum.)

Comptes-rendus des Travaux du Laboratoire Carlsberg. Vol. 20, No. 11. Studies on Enzymatic Histochemistry, 9–13. By D. Glick, Heinz Holter, K. Linderstrøm-Lang and A. Søeborg Ohlsen. Pp. 127+1 plate. (Copenhague: H. Hagerup.) 6.75 kr.

Survey of India. Geodetic Report 1934. Pp. xii+143+32 plates. (Debra Dun: Survey of India.) 3 rupees, 5*s*. 3*d*.

Svenska Linné-Sällskapets Årsskrift. Årgång 18, 1935. Pp. v+172. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.)

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 3: Gypsum in the Union of South Africa. By Dr. B. Wasserstein. Pp. 35. 1*s*. Geological Series, Bulletin No. 4: The Travertine Deposits near Port St. Johns. By Dr. W. Kupferburger. Pp. 15. 6*d*. (Pretoria: Government Printer.)

Straits Settlements. Annual Report of the Director of Gardens for the Year 1934. By R. E. Holttum. Pp. 9. (Singapore: Government Printer.) 50 cents; 1*s*. 2*d*.

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1934. Pp. 12. (Entebbe: Government Printer.) 1*s*.

Annuaire de l'Académie Royale de Belgique, 1935. Pp. 138+4 plates. (Bruxelles: Académie Royale de Belgique.)

Observatoire de Zi-ka-wei. Annales de l'Observatoire de Zô-Sè (Chine). Tome 20: Coopération de l'Observatoire de Zi-ka-wei à la Révision International des Longitudes, Octobre-Novembre 1933. Par R. P. Pierre Lejay, R. P. Maurice Burgaud, R. P. E. de la Villemarqué. Pp. 99+5 plates. (Sung-kiang: Observatoire de Zô-Sè.)

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WHITEHALL 8831

NATURE

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

No. 3428 SATURDAY, JULY 13, 1935 Vol. 136

Scientific Management and Social Problems

THE sixth International Conference on Scientific Management, which opens on July 15, comes at a time when the whole contribution of science not merely to industrial efficiency but also to every aspect of national and social welfare is receiving a searching examination. While on one hand there is a growing recognition that readjustments are required in our political and economic policies to enable us to take full human advantage of this age of science, technology and power production, while most people are disposed to regard a shorter working day or a shorter working week as an inevitable consequence of technological advance and as a desirable if not essential means of securing a wider distribution of leisure, there are strong forces setting in exactly the opposite direction.

The recognition that social control has not kept pace with the social change induced by scientific research and its applications has not always stimulated a resolve to use the full powers of the economy of science, technology and power production which man's genius has created. On the contrary, it has also induced the rise of a defeatism spirit which deliberately renounces many of the advantages with which the application of scientific thought and discovery can endow mankind, and attempts to return to the methods and conditions of the past. There is, in fact, a grave danger of a widespread revolt against science and of a social throttling of research, and the warning of Glenn Frank in "America's Hour of Decision" has a validity far beyond that of the American position of which he was particularly writing.

The obvious futility of attempting to set back the clock of progress should not lead scientific workers into the error of rejecting such warnings superficially. It must be recognised that, in the new civilisation created under the impact of science and technology, social change has so far outstripped institutional change that the survival of our social order has been in serious doubt in more countries than one. Neither a people nor a Government can be hastily condemned if under such conditions it clutches at any method to avert disaster. The task of the scientific worker is thus that of endeavouring to show a more effective alternative. What is required is a concerted effort by scientific workers, in physical and in social science, to plan the prosecution and publication of their research so that the scientific progress of the next twenty-five years shall stabilise and enrich the life of the nation instead of producing further social instability.

The views advanced by Glenn Frank on the situation in the United States deserve the more serious attention because in some countries scientific workers have already lost the freedom which they still enjoy in English speaking countries. Scientific workers must face the fact that the production of new knowledge cannot be regarded as automatically and invariably good. They must also recognise that the responsibility for considering the impact of modern science in modern society is not solely the responsibility of the worker in social science. It is equally the responsibility of the worker in physical science, and careless distinction between social and physical sciences is in fact one of our most serious dangers.

This changed attitude to science is due essentially to factors the influence of which is widespread. A growing dissatisfaction with maladjustments in society, and with the strain on the structure and functions of the political, social and economic

order due to *laissez-faire*, is accompanied by a growing disillusionment with research in which the production of new knowledge is unaccompanied by more effective effort to prevent its application causing more troubles than it cures. These factors alone, according to Dr. Frank, have been even more instrumental than financial stringency in determining the curtailment of expenditure on research in the United States of America in the last two or three years.

The third factor in this attitude to science, the determination to secure better planning and control of political, social and economic developments, enforces the necessity for more effective co-operation between scientific workers themselves. Earlier consideration of the political, social and economic effects of discoveries in the physical sciences or in industrial technology can only be secured by such co-operation. If we are to shorten to any adequate extent the dangerous time lag between the swiftly changing processes of industry and our slowly changing policies, we must develop some means of setting social science to work from the beginning, before social and economic havoc has been produced.

This may well prove an ideal which we cannot entirely realise. However, if it were possible to shorten by even a decade the time lag between technological development and developments in social or economic policy, much would have been done to alleviate distress and maladjustment and to mitigate the opposition to the spread of science. An advance of this kind presupposes the extensive application of scientific thought and methods to fields where they have scarcely begun to penetrate. It is, principally, over-specialised education which has left us so ill-fitted for the mastery of the problems of social management confronting us to-day.

The full significance of the International Conference for Scientific Management can only be appreciated against such a background as this, in the light of a well-founded determination for better planning and more effective control over the whole field of industry and politics, even if there is implied some restraint of scientific effort or change in its direction. Moreover, there are two basic questions on which the Conference may be expected to throw authoritative light and with which its programme indicates it will deal in some measure.

The first of these questions is that of the training of administrators and of securing an adequate and continuous supply of administrators of the requisite quality. The practice of scientific management depends primarily upon the capacity of the administrator, and if the general level of administration whether in industry or the State is to be raised, we cannot continue to rely upon those fortuitous methods of filling the higher managerial posts which have hitherto been the vogue in most industrial and commercial organisations in Great Britain. Some definite efforts must be made to secure a reservoir of personnel with sufficient initial training and experience to form the starting-point for selection for promotion to the higher ranks. This must be supplemented by systematic attempts on scientific lines to select from this reservoir those who give the most promise of qualifying for the higher administrative positions, and to ensure that they receive opportunities for further experience and training where required.

The maintenance of progressive prosperity depends largely on the continuous succession of able administrative leaders. It is also linked with the related problem of the place of the expert in modern government. Here, although in some sections of industry it may be fairly claimed that an adequate solution has been found, in social and political affairs the problem has received nothing like the same attention. All too frequently either the expert is allowed to usurp the place of the administrator and dictate policy to the neglect of other factors and the detriment of management, or, especially where the scientific expert is concerned, the administrator has proved incompetent or indifferent to the scientific factors involved.

It may be taken as axiomatic to-day that statesmanship must rest upon a scientific study of the causes of social problems and a statistical study of the results of social policies. The correlation of expert opinion and knowledge with legislative and executive leadership does not mean that policy should be determined primarily by expert advice. The expert is essentially a specialist in means, not in ends. He indicates the facts upon which a wise decision or policy must be based. As Dr. Glenn Frank points out, "the function of the expert is that of hewer of wood and drawer of water to the statesman". It is the latter whose patience and sense of social needs, values and possibilities, added to a knowledge of the facts, enable him to build up the broad policies required.

The real question at issue is how to provide administrators possessing at once the sense of values and the capacity to assess and interpret the

increasingly technical factors involved in almost every Government decision. The sessions at the Conference to be devoted to management problems arising from Government intervention can scarcely avoid the consideration of this particular question. A certain degree of scientific objectivity at any rate must be secured in public policy, and whether a new orientation of the methods of government as suggested by General Smuts is required, or whether the question is rather one of redressing the educational situation so as to ensure an adequate reservoir of administrators competent to assess scientific and technical factors in government, the matter is one urgently demanding serious study. Only in this way can we attain either the power or the vision to control the forces now at our disposal so as to ensure the maximum advantage to mankind. No less here than in other branches of human endeavour, the fullest freedom to creative thought and effort is an essential element in success, and indeed the only alternative to the renunciation and defeatism already characterising certain nations in this struggle to-day.

Notable Epidemics and their Causes

Some Notable Epidemics

By Dr. H. Harold Scott. Pp. xix+272. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

EPIDEMIOLOGY, after making slow but steady progress for a century or more in Great Britain, as the outcome of the work of the disciples of Sydenham—the so-called 'Annalists'—sustained a severe setback when the Industrial Revolution, with its crowding and neglect of sanitation, facilitated the spread of disease. Dr. John Snow's investigations into the cholera of 1848–49 may thus be said to have inaugurated a new era, making water-borne infection an established reality, and this stimulus, following upon the work of Mead, Pringle, Lind, Baker, Blane, Jenner, Thackrah and the three reports of the Poor Law Commissioners of 1838–39, greatly strengthened the hands of Chadwick and Simon in producing the health crusade of the latter half of the nineteenth century. Almost inevitably, therefore, Dr. Scott's Chapter i commences with an account of the "Broad St. Pump Outbreak" (1854).

It is, perchance, the 'irony of fate' which has determined that Snow's spade-work on this Westminster prevalence, followed as it was by Snow's and Simon's reports on the "Southwark and Vauxhall Water Outbreak" of 1854 and by Netten Radcliffe's report on the "East London Cholera Outbreak" of 1866, firmly established the belief in water-borne disease. There can be no surprise, however, at Sir John Simon's difficulty in accepting "Snow's peculiar doctrine", or his reserve regarding deductions drawn from reports on the cholera prevalences of 1854 and 1866.

A probable explanation of the difficulties in question, as resulting from failure to recognise the possibility of contemporaneous spread by shellfish, appeared in *Public Health* (Jan. 1923, pp. 98–106); moreover, as regards "The Pump", the official inquiry made at the bidding of a Committee for Scientific Enquiries, in 1855, clearly showed that "many cases in the infected districts occurred of persons who were not in the habit of using the pump water". This Chapter i and Chapters ii–vi, in which Dr. Scott deals with water-borne outbreaks of typhoid fever, at Blackburn (1881), Worthing (1893), Maidstone (1897), Lincoln (1904–5) and Bolton upon Dearne (1921) make exceedingly interesting reading; though here, again, there is something to be said (see *Public Health*, Dec. 1921, pp. 57–59) for the view that other influences than the water supplies were also at fault. It must be remembered that some sixty or more years ago, a president of the Society of Engineers was able to trace all cases of typhoid fever coming under his notice, in London, to faulty drains; and that in similar fashion water supplies enjoyed an almost complete monopoly of discredit as regards cholera and typhoid fever for several decades.

Chapters vii–xv present intriguing problems of a like character with reference to milk outbreaks of typhoid fever, diphtheria and scarlet fever; though here the claim to a monopoly for the suspected milk is stronger as a rule than was the case in the water outbreaks—in the case of the "milk-borne enteric fever outbreak" in St. Marylebone (1873), at any rate, the anomalies are, indeed, very disturbing; scepticism was voiced, at the time of the prevalence, and the difficulties, regarding "nursery milk" and "extent of involvement of domestic servants", are instanced on p. 61 of the paper in *Public Health*, Dec. 1921, referred to above.

Chapters xiii and xiv, dealing with outbreaks in which milk infection was traced to disease in milch cows, are particularly interesting. Chapter xv also deals with a milk outbreak, and Chapter xvi with two food-poisoning outbreaks. Then comes the masterpiece, the late Dr. H. T. Bulstrode's report on the "Oysterborne Enteric Fever of the Winchester and Southampton Banquets", of 1902. Hecker (who by a misprint appears as Heckel on p. xi of Dr. Scott's book), the author of "Epidemics of the Middle Ages", commented on the fact that Nature, in isolated epidemics, "never displays herself in all her bearings", but he would doubtless have maintained that Nature very rarely displays herself in *one* solitary bearing. On reaching Dr. Scott's Chapter xvii, however, we come very near to monopoly of infective property by one article of food. Dr. H. T. Bulstrode's report on the two banquets covers the whole ground, leaves no stone unturned, and preceded and followed as it was by his masterly reports on "Oyster and Other Shell Fish Layings", it brought about the remarkable reduction of prevalence of typhoid fever in Great Britain, which is one of the outstanding achievements of public health effort.

Dr. Scott's concluding chapters describe "Outbreaks at Aberdeen, 1919–1926" and "Sonne Dysentery Outbreaks, Aberdeen 1925–26", "Sonne Dysentery Outbreaks at St. Andrews, 1926" and "Sonne Dysentery Outbreaks at St. Pancras and Holborn, 1933".

Prof. W. W. Jameson, in his preface to Dr. Scott's book, writes: "Dr. Scott has performed a real service in producing this book"; the original reports have been so fully described "that the student will lose little, if anything, through inability to refer to the original reports", many of which "are now difficult to obtain". He adds, however, that he hopes "Some may be stimulated to a closer study of those older Reports from which much of the material in this book has been drawn".

Dr. Scott's book calls to mind Wordsworth's poem on "The Solitary Reaper", who sings of "Old unhappy far off things and battles long ago". The reports of Dr. Scott's public health pioneers are not only replete with interest, but also they constitute the foundations upon which rests the preventive medicine of to-day. Surely, then, it may be hoped that Prof. Jameson's wish may materialise and that Dr. Scott's book may prove a great help in letting all budding medical officers of health know that which "Our Fathers have told us".

W. H. HAMER.

Structure of the Eastern Dolomites

Geologie von Cortina d' Ampezzo und Cadore Von Dr. Maria M. Ogilvie Gordon. (Sonderabdruck aus dem Jahrbuch der Geologischen Bundesanstalt, Band 84, Heft 1–4.) Pp. 59–215 + 18 plates. (Wien: Geologische Bundesanstalt, 1934.) n.p.

THIS work describes the stratigraphy and tectonic structure of the Eastern Dolomites lying between Auronzo on the east and Caprile on the west and between the Drei Zinnen in the north and Cibiano in the south. It is illustrated by an excellent map (1 : 50,000) and by numerous explanatory sections. As stated by the author, greater attention is given to the tectonic structure than to the stratigraphy of the area.

Part 1 relates to the larger portion of the area lying east of the Ampezzo valley. Thirty-five pages are devoted to the stratigraphical succession between the Permian and the Upper Cretaceous, while eighty pages are devoted to the tectonic structure. The pre-Permian quartz-phyllites and the Grödner sandstone are limited to a small area east of Auronzo. The Bellerophon beds and the Werfener beds occupy a considerable area round Auronzo and Lorenzago, also in the Val-di-Cadore in the more denuded eastern margin; the author stresses the importance of Calcareous algæ and foraminifera in the formation of the limestones of the Bellerophon beds. The Mendola Dolomite also shows important algal development. The Upper Trias, notably the Schlern Dolomite and the Dachstein Dolomite, forms the whole of the central and northern portions of the district, and gives rise to important mountain cores with Wengen and Cassian beds clinging to their flanks (in the Cristallo, Sorapis, Marmarole, Antelao and Tofana groups), a few of these being capped by deposits of Lias and Cretaceous rocks.

In the description of the physical and tectonic structure, we are presented with a masterly account of the disturbances which the district has undergone. The detailed account of the various movements as deduced from the author's investigations and study of the work of previous writers makes fascinating reading, and the results are admirably depicted on the geological map and the diagrams accompanying the map.

The district appears to have been originally folded into a series of broad west-east anticlinal and synclinal folds, and these structures can still

be traced in the several strips in the central portion of the area, in the disposition of the mountain ranges composed of Dachstein Dolomite and in the significant anticlinal axis passing through the Tre-Croci Pass. Later movements, however, have disturbed the original simplicity of structure and bent up the mountain blocks into dish-shaped forms, notably the eastern margins of the Marmarole and Antelao. The main lines of movement were originally pointed out by Mojsisovics, and these and subsidiary lines of disturbance are described in detail by the author. The main lines have been given special names and have been traced more or less continuously through the district; they include both thrust-planes and normal and tear faults, indicating a general pressure from north to south. The most important lines are the Rauhtal line in the north, the Antelao line in the centre and the Val Sugana line in the south-east. The two former run in sinuous lines from west to east, while the last runs in a north-east–south-west direction in the neighbourhood of the Val-di-Cadore, and has given rise to a complicated series of tectonic structure. An interesting point is the association of valleys parallel to these lines of dislocation.

The second part of the work deals with the district west of the Ampezzo valley and contains also much of interest in connexion with the structure of the Tofana-Fannes group, the Pelmo range and the effects produced by the western continuation of the Antelao line of disturbance.

The author is to be congratulated on a fine piece of work which forms an important contribution to our knowledge of the structure of the Eastern Dolomites.

Progress of Physics

(1) International Conference on Physics, London, 1934

A Joint Conference organized by the International Union of Pure and Applied Physics and the Physical Society. Papers and Discussions. In 2 vols. Vol. 1: Nuclear Physics. Pp. viii+257. 10*s.*; cloth, 12*s.* 6*d.* Vol. 2: The Solid State of Matter. Pp. viii+183. 10*s.*; cloth, 12*s.* 6*d.* Reports on Symbols, Units and Nomenclature approved by the General Assembly of the Union at its Meeting in London on 5th October 1934. Pp. iv+40. 2*s.* 9*d.*; cloth, 5*s.* (London: Physical Society, 1935.)

(2) The Physical Society. Reports on Progress in Physics

Pp. iv+371+2 plates. (London: The Physical Society, 1934.) To non-Fellows, 12*s.* 6*d.* net.

(1) "THIS conference," remarked the owner of one of the most famous names in the physical science of to-day, "is a very good conference—as conferences go." Approbation from Sir Hubert Stanley is high praise indeed, and certainly the conference which met in London in the first week of October 1934 was unique of its kind. Held under the joint auspices of the Physical Society and the International Union of Pure and Applied Physics, and concerned with topics among the most important of those about which physical science is conversant, it is small wonder that the conference held, for a week, the attention of some five or six hundred members, drawn from almost every European country and from America.

The report of the conference is worthy of the occasion. It is published in three volumes which deal respectively with the solid state, with the present position of nuclear physics, and with certain problems of units and of nomenclature which have been discussed by the Symbols, Units and Nomenclature Committee of the International Union.

Conference reports are apt to be disjointed and—it must be confessed—lifeless; the present volumes are a pleasant exception. The topics are vividly interesting, and the programme has been developed in such a way as to show a very satisfactory coherence in the arrangement of the subjects.

Moreover, the great difficulty which faces the editors and readers is, in this instance, missing. Most readers who are not specialists in a particular branch of physics find that a major difficulty in following the papers presented is due to the authors' bad habit of plunging without apology *in medias res*, assuming in their readers a specialised knowledge which comparatively few possess. It is relatively easy to avoid this. A general introductory survey, indeed in many cases a few sentences of introductory matter, may make all the difference. Specialised matter is not always so esoteric as the non-specialist may suppose—clarity of thought and of expression, the art of beginning at the beginning, a kindly feeling for the other fellow—these are gifts that go far in helping to produce the Perfect Paper.

We hold no brief for nationalism in matters of science—*la chimie est une science française* is a

historic phrase which may well give pause to the enthusiastic nationalist—but, as a matter of plain fact, nuclear physics owes so much to Rutherford, and our knowledge of the solid state to Bragg, that the holding in London of an international conference dealing with these topics was most appropriate, and the conference was specially fortunate in that the discussions on the principal topics were opened by masterly surveys of the problems of nuclear physics and of the solid state contributed by these protagonists—surveys which form the opening addresses of the principal volumes of the conference report, and which serve admirably as introductions to the more specialised topics of the discussion.

It is quite impossible to give a detailed analysis of the contents of the volumes, and we must content ourselves with a brief catalogue of headings. The volume on nuclear physics contains sections dealing with general quantum theory, natural β-decay, artificial radioactivity, disintegration and synthesis of nuclei and elementary particles, and cosmic radiation. That on the solid state is divided into chapters which discuss the structure of molecules and of the ideal lattice, the deviations of real crystals from the ideal lattice structure, and plasticity and strain hardening in crystals. The papers are printed *in extenso*, the discussions are very fully reported, and one need say no more on the contents than that they represent the latest views on the subjects concerned, presented by physicists of international reputation.

The third volume of the report of the Conference—that dealing with symbols, units and nomenclature—may seem rather unexciting in comparison with its fellow volumes, but its subject matter is important, is thoroughly interesting, and presents a few intriguing problems for the physicist of philosophic mind. It is, for example, a little disturbing to the writer of elementary textbooks to be confronted with the statement that "complete agreement as to the definitions of B and H has not yet been reached".

(2) We turn now to the consideration of the first volume of what will, we trust, be a long and successful series of reports which will play an important part in the advancement of physical science. The report on the progress of physics issued by the Physical Society deals mainly with the events of the year 1933, although the fact that most of the surveys are the first of a series has allowed the contributors some measure of latitude, and earlier work, leading up to that of the year with which the reports are mainly concerned, is treated with the appropriate amount of detail. The reports contained in the volume are divided into two main groups—a set of reports which deal with general physics, sound, spectroscopy, optics, heat, X-rays, atomic physics and electrical and magnetic measurements. These titles are more or less permanent, so that reports under these heads will recur annually. The second group consists of a series of reports dealing with matters of topical interest, and the titles of these reports will vary from year to year. Under this head the present volume contains reports dealing with spiral nebulæ, Burgers' theory of turbulence, and electrical phenomena at extremely low temperatures. It has been found desirable to break up some of the reports into sub-sections contributed by specialists under the general direction of an editor. Thus, spectroscopy is split into twelve, X-rays into eight, and optics into five subsections.

It is not easy to settle the scope of such reports. What may be stated at once and decisively is that the reports are *not* mere expansions of *Science Abstracts*. They are popular in that they endeavour to present a review of different departments of physical science which shall be useful to the trained physicist who is not a specialist in the department under review—who wants to know, in fact, what is happening in branches of physics other than his own. They are specialised in that they offer full, critical and detailed accounts of the latest happenings in any particular branch of the subject, accompanied by very complete bibliographical details. An attempt to combine these two outlooks may seem to be courting failure, but it must be confessed that the reports combine these aspects very happily.

It is impossible, again, to deal with this report in detail, and it were invidious to particularise. But we cannot close this review without special mention of the brilliant contributions made by Prof. E. N. da C. Andrade, who deals with the physics of the atom, and by Prof. J. C. McLennan, who writes on electrical phenomena at very low temperatures.

No advanced worker in physical science can afford to neglect this report. The subject matter is extensive and important, the printing and production leave nothing to be desired, the price is low. If succeeding volumes preserve the high standard of the first volume, the success of the venture is assured.

British Scientists of the Nineteenth Century
By J. G. Crowther. Pp. xii + 332 + 12 plates. (London: Kegan Paul and Co., Ltd., 1935.) 12*s*. 6*d*. net.

COMPARATIVELY few historians of science have as yet recognised the powerful influence which social forces have had on the development of science, and it is characteristic of this book that Mr. Crowther sets out to overthrow the idea that scientific knowledge

originates entirely in minds completely detached from mundane affairs and concerned solely with the pursuit of truth for its own sake. He offers instead a picture of the lives of Davy, Faraday, Joule, Kelvin and Clerk Maxwell, in which we see how their characters were moulded by early upbringing, and the way in which their work was determined by various social and industrial influences. In revealing the extent to which other incentives besides the desire to contribute to the advancement of knowledge affected their careers, Mr. Crowther gives us a highly stimulating series of studies which appear appropriately at a moment when scientific workers are considering much more seriously both the social consequences of their work and the social factors which determine its extent or direction.

The selection of four physicists and a physical chemist as the most representative men of science of the century is defended on grounds that there were few outstanding figures in the fields of medicine, geology, botany and zoology during the period, in itself an example of the way in which the sciences which promised the greatest direct contribution to the prosperity of industry were the most richly endowed, while the biological, sociological and psychological sciences, which could offer no such immediate return, were much less generously encouraged. Although the author's opposition to capitalism tends to obtrude at times, it scarcely detracts from the fascination and suggestiveness of what is not merely biography but also to some extent a study of the effect of social conditions on the general development of science during the period.

R. B.

A Text-Book of Physical Chemistry

Vol. 2: Principles involved in Chemical Reactivity. By Dr. J. Newton Friend. Pp. xii+483+3 plates. (London: Charles Griffin and Co., Ltd., 1935.) 24*s*. net.

THERE is a pleasantly classical flavour about the second volume of Dr. Friend's treatise. Most of our old acquaintances are there, and though the ultra-modern physicist, "trained in an atmosphere of rigid economy of mechanical concepts" (an economy, Heaven help him, which leads on occasion to glib outpourings concerning the uncertainty principle, and a discreet silence concerning the mode of action of a locking-nut), may find overmuch of ancientry in the exposition, the student who has attacked the fundamentals of physical chemistry with the aid of Dr. Friend's two volumes will not have a great deal to unlearn. The principal topics to which the ten chapters of the second volume are devoted are thermochemistry, chemical equilibrium, reaction velocity and chemical change in homogeneous systems, combustion in gases, the phase rule, catalysis, electrochemistry, the structure of the atom and of the molecule, and chemical thermodynamics.

The treatment is throughout clear, concise and elementary. Broadly speaking, the treatise will serve to lay the foundations for an advanced honours course.

A. F.

The Biology of Bacteria: an Introduction to General Microbiology

By Prof. Arthur T. Henrici. Pp. xi+472. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THIS book, as explained in the preface, is intended as an introduction to microbiology in its scientific aspects as distinct from its practical applications in hygiene, agriculture and industry. The author, indeed, considers that the lower unicellular micro-organisms present problems sufficiently important to warrant microbiology being considered as a separate branch of biology, distinct from either botany or zoology. At the same time, when dealing with individual organisms, their rôle in the causation of disease, or their importance in agriculture and industry, are adequately described, and immunity, antibodies and antisera, agglutination and the like, are all considered.

After a brief history of bacteriology and some details respecting the microscope, the microbic life of the Protozoa, Algæ, Fungi, Bacteria and other unicellular groups is considered. In these chapters the structure, nutrition, reproduction and other functions of each group are surveyed. The 'ultra-microbes', the finer structure of Bacteria, and the subjects of heredity, variation and metabolism in this group form the subject of several chapters. In this connexion, the author has definite views on the meaning and importance of Gram-staining, holding that the Gram-positive species form a homogeneous group distinct from the Gram-negative species, and bringing them in relation to the Fungi. In the many instances where alternative hypotheses are possible, for example, as regards the nature of 'bacteriophage', these are clearly stated.

The book is well produced and illustrated, and gives an excellent account of the biology of the Bacteria.

R. T. H.

Zur Erforschung des Weltalls: acht Vorträge über Probleme der Astronomie und Astrophysik

Von P. ten Bruggencate, E. F. Freundlich, W. Grotrian, H. Kienle, A. Kopff. Herausgegeben von W. Grotrian und A. Kopff. Pp. x+286. (Berlin: Julius Springer, 1934.) 19.80 gold marks.

THIS is not in the strict sense a popular book. It is, however, an account by a group of well qualified German astronomers of some of the recent researches and outstanding problems in their subject, written for readers with a reasonable knowledge of mathematics and physics. The authors' names are a sufficient guarantee of the quality of the volume. The subjects discussed—methods of astrometry, the physical condition of the stars, their inner constitution and evolution, the structure of the stellar system, the sun—reflect a sound choice from the whole range of astronomical knowledge. The volume arose from a series of eight lectures given to a circle of engineers at Charlottenburg in 1933. It is freely and well illustrated and attractively set out. It fills what is probably a real need in astronomical literature.

Temperature Changes in the Higher Atmosphere

By Prof. E. V. Appleton, F.R.S.

UNTIL some years ago, it was generally thought that the temperature of the stratosphere was practically uniform, and of the order of 220° K. A radical change in such notions was first effected by Lindemann and Dobson who, in 1922, from their study of meteor tracks, showed that the temperature at levels above 60 km. was even higher than that at ground-level. Their conclusions have been adequately confirmed recently in experiments on the anomalous propagation of acoustic waves, on the vertical distribution of ozone with height and, to some extent, by direct temperature measurements in high balloon ascents. There is, then, trustworthy evidence that solar radiation does not pass through the middle part of the atmosphere without warming it, so that we are led to examine, in this connexion, the evidence relating to still higher atmospheric levels, where such heating might be expected to be especially pronounced, since the solar radiation is there most intense and the thermal capacity of the transmission medium least.

Within the last year or so, the study of the diurnal and seasonal changes in upper-atmospheric phenomena by radio methods has indicated that surprisingly high temperatures are attained at great heights (200–400 km.) and that these temperatures vary in a most pronounced manner. These conclusions have been reached by comparing the observed diurnal and seasonal variations of ionisation with those expected according to a simple theory of photo-ionisation by solar radiation. It is now well known that there are two main regions of ionisation in the upper atmosphere, the lower of which (Region *E*) is the Kennelly-Heaviside layer. Now the maximum ionisation content of the Kennelly-Heaviside layer varies with the hour of the day and with the season of the year much as simple theory predicts. For example, the ratio of summer to winter noon maximum ionisation depends on the zenith distances attained by the sun at noon in summer and in winter. For the latitude of Great Britain, a simple calculation shows that the theoretical value of this ratio should be 1·84, and observations made at the Slough Radio Research Station of the National Physical Laboratory and at the Halley Stewart Laboratory, Hampstead, London, yield an experimental value agreeing very closely with this.

This agreement indicates that, at the level of the Kennelly-Heaviside layer (100 km.), there is little change of air density or temperature throughout the year. But above the Kennelly-Heaviside layer there is a much more intensely ionised region, Region *F*, and corresponding measurements in this case provide no such agreement with theory. For example, the critical penetration wireless frequency, by way of which the maximum ionisation is measured, is found to be actually less on a summer noon than on a winter noon, indicating that, in contrast to the results obtained for Region *E*, the maximum ionisation in Region *F* is less on a summer noon than on a winter noon. This result appeared at first sight so startling that some workers concluded that the critical frequency method of measuring atmospheric ionisation was untrustworthy, and that observations made by it could not be accepted. But further work carried out in Great Britain indicates that the method of measurement is trustworthy, and we must face the consequences of these unexpected results. Discrepancies between theory and experiment are always interesting, for from the discrepancy we can often measure the magnitude of the perturbing factor.

Fortunately, in this case, an explanation is to hand. The theory which indicates that summer noon ionisation should be nearly twice that on a winter noon is founded on the assumption that the atmospheric distribution of molecular density with height is constant throughout the year. It is not difficult to show that the abnormally low value of summer noon ionisation density can only be the result of a reduced summer air density at the level in question, otherwise we should have to assume that the solar ionising rays differed in quality from summer to winter. Such a reduced air density can again only be the result of an increased temperature. Putting these ideas into quantitative form, we find that the molecular temperature must be three to nine times as high on a summer noon as on a winter noon, and that the absolute temperature at a level of 300 km. must be at least 1,200° K. on a summer day.

An equally interesting result emerges from the interpretation of the corresponding nocturnal ionisation measurements. When the sun sets, it is found that the rate of decay of Region *F* ionisation, which has been proceeding in accordance with the decreasing zenith distance of the sun, is quite suddenly checked on a winter night. It appears as if there were brought into action a

new source of ionisation, but this is not so. The effect is due to the shrinkage of the outer layer of the atmosphere due to cooling, which brings about a concentration of both molecules and electrons. (Note that wireless methods measure not total ionisation but maximum ionisation per unit volume.) It is found that the concentration of electrons due to upper-atmospheric shrinkage can more than offset the dilution due to recombination processes, and an actual maximum of ionisation content is attained in winter, shortly after midnight. In midsummer no such marked cooling process takes place (for the sun never sets at heights of above 250 km.) and the ionisation (apart from occasional increases which are probably due to a nocturnal ionising agency) is generally found to decay steadily.

The theory of marked temperature changes also suggests an explanation for the curious alteration of structure which Region F undergoes on a summer day. It was shown in 1933 that there is found in our latitudes a subdivision of Region F during daylight in summer. When distinction is necessary we refer to the lower part, which forms a kind of 'step' on the upper part, as Region F_1, while the upper stratum is referred to as Region F_2. Since Region F_1 is found not to exhibit marked temperature changes, it is quite possible that the subdivision is partly, if not wholly, the result of the difference of the temperatures at the two levels, Region F_1 being at the lower temperature and Region F_2 at the higher temperature. According to this view, Region F_2 is, as it were, part of the main Region F forced upwards by expansion. At night, when the atmosphere shrinks, the two regions tend to merge into a single simple region. It is thus not improbable that differences of temperature in the atmosphere, as well as differences in molecular constitution, play a part in causing the composite structure of the ionosphere.

It might appear that these extraordinarily large changes of temperature at high atmospheric levels could not possibly have any influence on wireless communications, but such is not the case. Due to the expansion of the upper atmosphere on a summer day, the maximum electronic density, which determines the shortest wave-length usable in round-the-world communication, is abnormally low, and we are therefore unable to use a valuable range of short wave-length channels. Fortunately, however, Nature provides us to some extent with a form of compensation, for it is found that in summer there is very frequently produced a curious highly-reflecting stratum about the level of Region E, which provides abnormally favourable transmission conditions for short waves. But such conditions do not occur daily and so cannot be relied on wholly to remove the unfavourable conditions brought about by the solar heating and expansion of Region F_2 on a summer day.

Implementiferous Gravels of the Vaal River at Riverview Estates

By Prof. C. van Riet Lowe, Bureau of Archæology, Dept. of the Interior, Johannesburg

TOWARDS the end of April last, Mr. F. W. Webber, chairman of Carrig Diamonds, Ltd., very generously presented a collection of stone implements and a variety of deeply mineralised faunal remains to the Bureau of Archæology recently established at the University of the Witwatersrand. These had been recovered from diamondiferous gravels on the property of Carrig Diamonds, Ltd., at Riverview Estates on the left bank of the Vaal River immediately opposite Windsorton (lat. 28° 20′ S., long. 24° 44′ E.) shown on the accompanying sketch plan (Fig. 1). As similar remains were still being recovered, I immediately requested Dr. S. H. Haughton, director of the Geological Survey of the Union of South Africa, to accompany me to the site with the object of a detailed investigation. Mr. F. W. Webber had kindly offered to accompany and guide us, and an examination of the area was accordingly carried out during the second week in May.

The ancient gravels were found to be extremely rich in implements and faunal remains, and the occurrence, as a whole, unusually interesting and embracing. Until we are in a position to publish detailed reports, however, the following occurrences are noteworthy.

1. The 60 ft. terrace, shown as Site No. 5 on the accompanying 'composite sections' drawing (Fig. 2), comprises a thin layer of gravels that caps the old peneplain some sixty feet above the present flood plain. Inclement weather precluded the possibility of a thorough examination, but in the time at our disposal we were unable to find even traces of the manufacture of stone implements.

2 (*a*). In the lower terrace, actually an old river gravel, marked 'G' on sections 1, 2, 3 and 4 in Fig. 2, we recovered a few heavily rolled Lower Stellenbosch (Chelles plus Clacton type) tools and a great abundance of rolled and unrolled Upper

Stellenbosch (Acheul plus Proto-Levallois type) tools and the completely mineralised remains of a variety of extinct animals which Dr. Haughton will describe when he publishes his geological and other data.

In this Upper Stellenbosch congeries we have further definite proof, were this indeed required, that the so-called Victoria West industry merely represents the factory-site debris of the Upper Stellenbosch culture[1], for in addition to very many fine hand-axes and cleavers worked on flakes, we found numbers of detaching hammers and typical Victoria West cores from which the flakes (large and small) used for these axes and cleavers were struck. Several cores are normal in size, that is, up to about 9 in. in length, but others are more than 15 in. long by 8–10 in. broad and deep and up to 150 lb. in weight. Twelve-inch flakes were struck from these great cores—cores frequently trimmed in typical Victoria West fashion *before* the flakes were removed. The materials preferred comprise varieties of Ventersdorp lava and quartzites, the weathering properties of which are entirely different from those of Victoria West (Karroo) dolerites, where insolation is common. No doubt whatever can be cast upon the purposeful shaping of these cores as a preliminary to the removal of the flakes that were ultimately trimmed into hand-axes and cleavers that vary from about three to ten inches in length.

It is this technique that I have in the past referred to as Proto-Levalloisian[2]—a highly specialised technique that enabled the manufacturers to produce axes or cleavers at will—a technique apparently unknown out of South Africa, though, I must confess, I suspect its occurrence in southern India. Once this special technique is understood and it is realised what a great proportion of the tools are cleavers, the necessity for breaking away from the use of such terms as 'Chellean' and 'Acheulean' will be more readily appreciated.

(*b*) The occurrence of rolled and unrolled implements and factory site debris at all levels in the gravels establishes the fact that the makers of Upper Stellenbosch tools occupied the valley before and during the deposition of these gravels. Dr. Haughton is equally satisfied that the animals, the fossil remains of which we recovered, also occupied the valley during this period. The animal remains include horse, buffalo, antelope, at least one large carnivore, hippopotamus, etc.

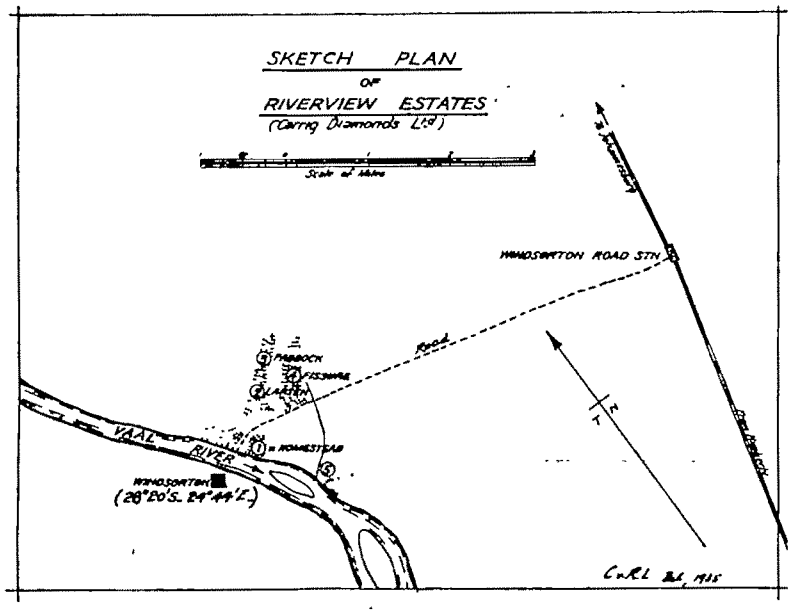

FIG. 1.

3 (*a*). Overlying these ancient gravels is a layer of silt and calcareous tufa that varies appreciably in texture and depth. But for a single *biface* (not seen) reported by Mr. Larsen as having been found at a depth of 15 ft. below the natural ground surface at Site No. 2, the silts and tufas of Sites Nos. 2, 3 and 4 appear to be sterile. At Site No. 1, marked 'Homestead' in Fig. 2, the silt is a loose sandy soil that is subject to movement by wind and rain. At Site No. 2 ('Larsen'), the silt is well consolidated and toward the surface passes into a calcareous tufa. The fact that 35-ft. high walls remain vertical without supports is illustrative of the high degree of consolidation. Except for three feet immediately over the gravels, penetration can only be effected by means of picks. This is largely, if not wholly, due to the formation of calcareous tufa in the deposit. Larsen's Site (No. 2) is probably the most interesting.

The diamondiferous gravels occur 35 ft. below the present ground surface and extend laterally over several acres, at a distance of 1–1½ miles from the river. They are reached by vertical shafts through the calcareous tufa and silt, and are 'worked' by means of tunnels. Shafts are sunk at fairly close intervals and intercommunication is maintained until the gravels are 'worked out' or a collapse occurs. We were able to walk about in these underground corridors, and with the aid of torches, to examine the undisturbed gravels in comfort.

At Site No. 3 ('Paddock'), situated about a

quarter of a mile from Site No. 2, the excavation is a huge open hole the walls of which are vertical and the silt therefore obviously also well consolidated. Immediately above the gravels the silt is a fine, clean sand—water-worn and false-bedded. Higher up the calcareous tufa occurs again. All these walls, both in shafts and open excavations, appeared to be sterile.

Between Sites Nos. 3 and 4 there occurs a barren patch, and at Site No. 4 the gravels and silt alternate as shown.

(*b*) At Site No. 1 ('Homestead'), the silt and later loose sand that cover the surface yielded a complete assemblage of Lower Fauresmith (mainly Micoque and Old Levallois type) tools. As this is only the second discovery of Stellenbosch-Fauresmith stratification, it is most important. The first was recorded six years ago[3]. Small and well and neatly trimmed hand-axes, two cleavers, a scraper, several Levallois type flakes, fabricators, etc., were recovered—a good assemblage in a stratum very much more recent than the underlying gravels with their Upper Stellenbosch remains. The tools are almost exclusively of indurated shale (lydianite), though lava and quartzite appear also.

4. Lying entirely on the natural ground surface or just below the superficial shifting sands at Site No. 1 and at the foot of the scarp at Site No. 5, I collected deeply weathered Middle Stone Age (Late Levallois cum Moustier type) and slightly weathered remains of the Middle Smithfield (Capsio-Aurignacian type) culture.

The Middle Stone Age material is recognisable, but somewhat nondescript—mainly unworked flakes and a few small and inferior cores—but the Later Stone Age (Smithfield culture) comprises the usual variety and number of duckbill end-scrapers, side- and thumbnail scrapers, one bored-stone, one grindstone and one well-worked elongated phallus-like cylindrical artefact, truncated at one end and nosed at the other, 8¼ in long with a maximum diameter of 2¼ in.

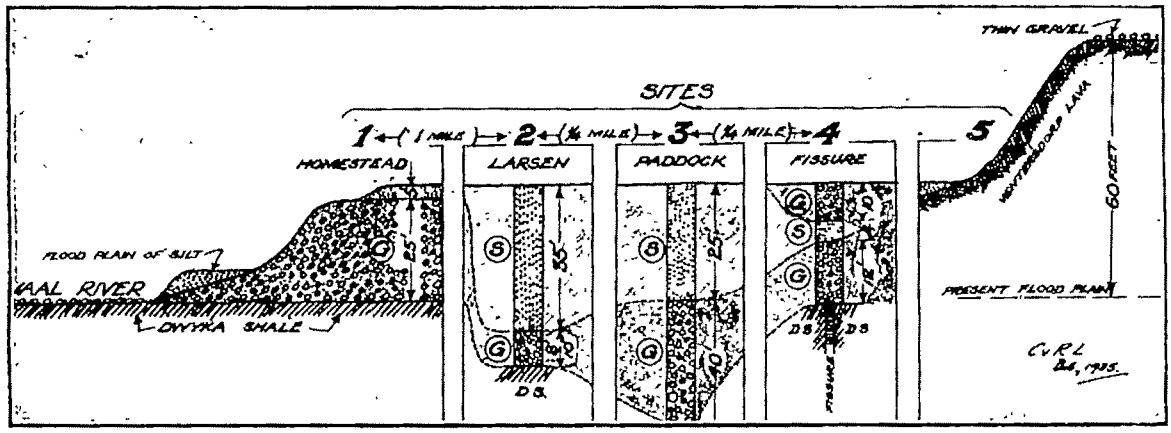

FIG. 2. Composite (diagrammatic) sections of the left bank of the Vaal River at Riverview Estates

SUMMARY OF STRATIFICATION

1. Slightly weathered Middle Smithfield (Capsio-Aurignacian type) and much weathered Middle Stone Age (Late Levallois cum Moustier types) on surface at Site No. 1 and at foot of scarp at Site No. 5.

2. Deeply incrusted Lower Fauresmith (La Micoque cum Old Levallois types) in silt and loose sand capping gravels at Site No. 1.

3. Rolled and unrolled Upper Stellenbosch (Acheul plus Proto-Levallois type) implements and factory-site debris (Victoria West cores ≡ Proto-Levallois technique) and heavily rolled Lower Stellenbosch (Chelles plus Clacton-like flakes) throughout gravels at Sites Nos. 1, 2 and 3.

4. Three heavily rolled Clacton-like flakes of the Lower Stellenbosch recovered from mounds of 'worked' gravels removed from Site No. 4 after excavation. Horizon unknown.

In submitting this preliminary report, I do so with the hope that the larger and more detailed publications will not be long delayed. Dr. Haughton has very kindly undertaken to deal with the geology, palæontology and climatology of the area and the periods affected, and in doing so will, I have no doubt, add weight to my oft-expressed opinion that such closely related major problems as these that do not fall within the strictly specialised field of the prehistoric archæologist *qua* archæologist, should be left entirely to the other specialist or specialists concerned. It is only with the fullest support of the pleistocene geologist that

the archæologist can hope to solve the problems of early human cultures not only in Africa but also elsewhere.

In conclusion, I would like to express my great indebtedness to Mr. Webber and to Messrs. R. W. Hardy and Larsen, who put themselves, their discoveries and vast knowledge of the 'diggings' entirely at our disposal. To Mr. and Mrs. Hardy we are deeply indebted for hospitality during a particularly inclement week.

[1] Van Riet Lowe, C., "Fresh Light on the Prehistoric Archæology of South Africa", *Bantu Studies*, 3, No 4, 388; 1929.
[2] "The Prehistory of South Africa in Relation to that of Western Europe", *South African J. Sci.*, 29, 756; 1929.
[3] Van Riet Lowe, C., "Notes on the Archæology of Sheppard Island", *Ann. South African Mus*, 27, 235; 1929.

Tercentenary of Robert Hooke, 1635-1703

OF all the scientific worthies of the seventeenth century, none will be remembered longer than Robert Hooke, whose views and activities influenced the progress of scientific thought and practical physics in an incalculable degree. Somewhat younger than Boyle, Wilkins, Wren, Mariotte, von Guericke and Huygens, but the senior of Flamsteed, Newton, Leibniz and Halley, he belonged to an age in which, in the words of Macaulay, "it was almost necessary to the character of a fine gentleman to have something to say about air-pumps and telescopes". Born when James I was king, Hooke was a schoolboy in Westminster when Charles I was beheaded, a scholar at Oxford when Cromwell was Protector and an assistant to Boyle at the time of the Restoration. As curator, and sometime secretary, he faithfully served the Royal Society during practically all the reigns of Charles II, James II and William and Mary, and died a year after Anne ascended the throne. Affairs of State and Church, however, made little difference to Hooke, and in the main his life was taken up with writing, lecturing and experiment. In the records of the first forty years of the Royal Society, no name is more frequently met with than his, and in his various capacities of curator, Gresham professor of geometry and Cutlerian lecturer on mechanics, he probably delivered more scientific discourses and made more experiments than any other man of his day. His influence was felt both at home and abroad, and the story of his life belongs to the history of our race in the same way as those of his contemporaries Dryden, Locke, Evelyn and Pepys.

Hooke was the son of the Rev. John Hooke, a curate of Freshwater, Isle of Wight, where he was born on July 18, 1635. He was a somewhat delicate child, and was kept at home until his father's death in 1648, when, after a short time with Lely, the portrait painter, he entered Westminster School and thus came under the famous Dr. Busby. Studious and inventive far beyond the average, at eighteen years of age he became a chorister and servitor at Christ Church, Oxford, and during the next eight or nine years gained the friendship of Wilkins, Ward, Willis, Petty, Boyle and other men of science, whose meetings at Oxford had much to do with the inauguration of the Royal Society in 1660.

The turning point in Hooke's career came in 1662 when, as the Journal Book of the Royal Society records, "Nov. 12, 1662. Sir Robert Moray proposed Mr. Hooke as a curator of experiments to the Society . . . and that Mr. Hooke should come and sit amongst them, and both bring in every day of the meeting three or four experiments of his own, and take care of such others, as should be mentioned to him by the Society". His connexion with the Society was strengthened next year by his election as a fellow, and in 1665 by his appointment to the chair of geometry in Gresham College, where the Society at that time met, and where Hooke lived for the rest of his life. He had already in 1664 been appointed to the lectureship founded by a city merchant, Sir John Cutler, Bt., and thus at thirty years of age Hooke found himself established in surroundings which must have appeared to him as congenial as those at the Royal Institution did to Faraday a century and a half later.

Of Hooke's versatility, originality and inventiveness ample evidence is to be found in his writings, but new and valuable information as to his activities in early middle life is contained in the "Diary", the recent publication of which we owe to Mr. H. W. Robinson and Mr. W. Adams. This diary covers the years 1672–80, when, in addition to his other appointments, Hooke was one of the surveyors of the City of London. The biographical index to the diary contains several hundreds of names, among them most of his scientific contemporaries.

Hooke himself was at once a physicist, an astronomer, an inventor, a mechanician and an architect. To horologists he is known for his application of the balance spring and the invention of the anchor escapement; by engineers he is remembered for his universal joint and his views

on elasticity; as an instrument maker he made improvements in thermometers, barometers, air pumps and microscopes, and he devised sounding apparatus for sailors and calculating machines. He was the first to describe the cellular structure of plants and the first to suggest the use that might be made of fossils in revealing the history of the earth. He had advanced views on gravity, colours and light, respiration, combustion and the nature of heat. His "Micrographia", published when he was thirty years of age, was the first major treatise on the microscope and microscopy. His "Attempt to prove the motion of the Earth" was published in 1674; his "Description of Helioscopes" in 1676; his "Cometa" in 1679. Many of his lectures and writings, however, were only published after his death. They are all full of pregnant suggestions, and as Dr. Singer says: "No Englishman of science has outlined so many and so variously important discoveries".

It was the Great Fire of London in 1666 which led Hooke to become an architect. While the ruins of the city were still smouldering, he produced a plan for rebuilding it. Although his plan was approved by the Royal Society, it was not adopted; but on October 4, 1666, the City made him one of its surveyors. Henceforth much of his time was taken up in attending committees, superintending the rebuilding of houses and designing structures such as the Bethlehem Hospital, Moorfields, Montagu House, which stood on a site now covered by the British Museum, the Merchant Taylors' Hall, and numerous churches and private residences. It was from this work that he accumulated the large sum of money which he intended to bequeath for the purpose of erecting a library, repository and laboratory for the Royal Society, a project which, however, came to nothing owing to his failure to make a will.

"There is a peculiar fascination," said Lord Oxford, "in trying to pierce through the gloom which veils the life-history of some of the most famous of our race." In endeavouring to do this in the case of Hooke, the newly-published "Diary" will be of the greatest interest. Hitherto opinion has been largely influenced by the remark of his biographer, Richard Waller, who said that "his temper was melancholy, mistrustful and jealous, which more increased upon him with his years". Always somewhat of a valetudinarian, Hooke had his share of troubles, and the picture of him as a lonely old bachelor in his somewhat neglected apartments in Gresham's decaying mansion in Bishopsgate Street no doubt is a true one. But in the "Diary" he is seen as a man of forty, mixing freely with his fellows, meeting at many coffee-houses and taverns, discussing a hundred different matters. His friend John Aubrey, the antiquarian, writing about this time, said of him: "He is of middling stature, somewhat crooked, pale faced; and his face but little belowe, but his head is large; his eie is full and popping, and not quick; a grey eie. He has a delicate head of haire, browne, and of an excellent moist curle. He is and ever was very temperate and moderate in dyet, etc. As he is of prodigious inventive head so he is a person of great vertue and goodness."

There is, unfortunately, no portrait of Hooke. Neither is there any monument to him. He died in Gresham College on March 3, 1703, and a day or two later, in the presence of the fellows of the Royal Society, was carried across Bishopsgate Street to St. Helen's and there laid to rest in the chancel. The exact site of his grave is not known, but at the west end of the Nun's Choir of the church is a window of five lights to ten Worthies of St. Helen's, among the names of whom is that of Robert Hooke.

Obituary

Prof. Alice Werner, C.B.E.

WE regret to record the death, which took place at Welwyn Garden City on June 9 at the age of seventy-five years, of Prof. Alice Werner, emeritus professor of Swahili and Bantu languages in the University of London.

If the study of questions relating to the African in Great Britain has been determined largely by the influence of Mary Kingsley, the study of the Bantu languages and mentality as an academic subject owes no less to Prof. Werner. She was born at Trieste on June 26, 1859, and educated at Newnham College. An unusual gift for languages and an absorbing interest in certain aspects of the mentality of the less-sophisticated peoples drew her to Africa. From 1893 onward, she lived there for some time at first with the Scottish Mission at Blantyre in Nyasaland, and afterwards in South Africa, where she was deeply influenced during her study of the Zulu language and people by the Misses Colenso, the daughters of the famous Bishop of Natal, and laid the foundation for that sympathetic understanding of the Bantu peoples which was such an outstanding feature in her academic and literary work. A second visit to Africa took place in 1911, when she spent two years as Mary Ewart travelling scholar of

Newnham College in visiting various peoples in East Africa. On her return in 1913 she was made a research fellow of her college.

Miss Werner's most important services to African scholarship date from 1899, when she opened a school for the study of African languages in Westminster, which was afterwards transferred to King's College and recognised by the University of London, while Miss Werner became successively lecturer, reader and professor. On the opening of the School of Oriental Studies of the University of London in 1917 she was appointed lecturer in Swahili and Bantu, and the position these studies now hold in the School is due to her enthusiasm and untiring energy.

In 1930, Miss Werner became emeritus professor, after receiving the degree of D.Litt. in 1928. In 1931 she was awarded the Silver Medal of the African Society, of which she was a vice-president at the time of her death, and in the same year was made a C.B.E.

Miss Werner was the author of a number of works dealing with African languages and folklore, among the best-known being "African Mythology" (1926) and the scholarly and at the same time delightful "Myths and Legends of the Bantu" (1933), while "The Structure and Relationship of the African Languages" (1930) sums up the results of many years study of matèrial gathered at first-hand as well as critical examination of the work of other scholars. Miss Werner was a constant contributor to the periodicals of learned societies and the reviews. She wrote with a light touch which was derived from a thorough mastery of a wide range of knowledge; and, if an exacting critic, she was ever kindly, and her criticism constructive.

News and Views

Cultural Succession in the South African Stone Age

A PRELIMINARY report by Prof. C. van Riet Lowe on a discovery of faunal remains and stone implements of early man in the diamondiferous gravels of the Vaal River (see p. 53) is the first account in any detail to reach Great Britain of a firmly established archæological succession in the early stone age cultures of South Africa, which, it is safe to predict, will be a standard of reference in future research. From the evidence of five sites on the Riverview Estates, a diagrammatic section of stratification has been constructed which shows a regular chronological succession of cultures in the Lower, Middle and Later Stone Ages from 'Chellean' to 'Capsio-Aurignacian'. Points of special significance emerging are the identification of the much discussed so-called Victoria West industry, with its gigantic stone cores, as the factory *débris* of the Upper Stellenbosch of Lower Palæolithic age; the occupation by man of the Vaal River Valley both during and after the deposition of the old river gravel—the full significance of this will appear on publication of the palæontological evidence; the confirmation of the chronological relation of Upper Stellenbosch and Fauresmith cultures, the latter being shown by stratigraphic evidence to be of much later age; and the local specialisation in South African cultures and technique, which renders inept the application of a West European terminology. While the author refrains from broader inference, pending the opinion of experts on geological, climatological and palæontological evidence in a report now in preparation, the conclusion is warranted that this discovery will have more than local significance, especially as a contribution to the study of the great hand-axe culture, characteristic of Africa, but of highly specialised technique in South Africa, and distributed from Great Britain to India and even beyond.

Presentation of the Albert Medal to Sir Robert Hadfield

H.R.H. THE DUKE OF CONNAUGHT, president of the Royal Society of Arts, presented the Society's Albert Medal for 1935 to Sir Robert Hadfield on July 8 "for his Researches in Metallurgy and his Services to the Steel Industry". In making the presentation the Duke of Connaught said: "It gives me very particular pleasure on this occasion to present the Albert Medal of the Royal Society of Arts, a very high honour, which was founded in memory of my father, to one who has been a personal friend and a charming next door neighbour of mine in the south of France for many years. Your labours in the application of scientific research to the great steel industry have contributed greatly to its progress. As far back as 1882, by the discovery of manganese steel, you opened a new chapter in the history of metallurgy, and this remarkable alloy, which has found many uses in engineering and in mining, has also stimulated research into the causes of its unique hardness, and into the structure of the alloys of iron. As an industrialist, you have given great encouragement to scientific research in metallurgy by your example, and you have consistently upheld the view that the future of industry in this country is closely bound up with the attention which it gives to research". Sir Robert Hadfield, in accepting the Medal, expressed his gratification at the honour conferred on him by the Society and reaffirmed his faith in the value of research. Speaking in particular of metallurgy, he referred to the fact that among the previous recipients of the Medal were Bessemer and Siemens. For himself, he said that during his life he had done his utmost along with many others "to raise metallurgy from an empirical art to a true and important branch of modern science. I venture to add without fear of contradiction that the study and practice of metallurgy is no longer empirical but

is now based on scientific and orderly lines and has become just as much a part of science as engineering, chemistry and physics".

Retirement of Prof. A. Morley Davies

AFTER more than thirty years' service as demonstrator, lecturer and assistant professor, Dr. Arthur Morley Davies will shortly retire from the Department of Geology of the Imperial College of Science and Technology and readership in the University of London. Opportunity was taken by his colleagues in the Department to make him a presentation on Tuesday, June 25. Prof. Boswell recalled that Prof. Davies joined the College fifty-one years ago, and became a member of a stimulating group of students which included such well-known figures as H. G. Wells, R. A. Gregory, A. T. Simmons, A. E. H. Tutton and A. V. Jennings. Tribute was paid to Prof. Davies for his long and devoted services to geology, to the College and to learned societies. The Royal Geographical Society conferred honorary fellowship on him, and the Geological Association honorary membership, as a mark of appreciation of his help and counsel during many years; and the Geological Society awarded him its Murchison Fund and, later, its Lyell Medal in recognition of his original work. Prof. Davies is the author of text-books of geography, local geology, palæontology and, recently, of two volumes on the Tertiary faunas, which will long remain a standard work of reference.

Memorial to Sir Patrick Geddes

THE Outlook Tower, standing on the Castle Hill, Edinburgh, was intended by the late Sir Patrick Geddes to express and exhibit stages of social development, using the history and geography of Edinburgh and Scotland as particular illustrations, and passing from them to the British Empire, the United States of America, Europe, and the world as a whole. The Tower was founded by him in 1892 as a type museum of geography, history and sociology and as a centre of civic and regional study; and it will always be associated with his name. There could be no more appropriate means of commemorating Sir Patrick Geddes' work and influence than by establishing the Outlook Tower upon a permanent basis, and thus enable it further to be developed as an active centre for the dissemination of his ideas. With this end in view, a memorial, signed by a number of his friends and admirers, has been circulated, inviting contributions and asking also for the loan of any original letters or personal reminiscences, which with a considerable body of material already collected will be classified and edited so as to be available to students of civics and sociology. As Geddes was the apostle of town and regional planning, and devoted his life to promote intelligent and stimulating relationships between man and his environment, we hope that the response to the appeal now made will be ready and generous. Contributions should be sent to Sir Thomas B. Whitson, 21 Rutland Street, Edinburgh, and letters or other personal communications bearing upon Sir Patrick Geddes' life and work to the honorary secretary, Outlook Tower, Castlehill, Edinburgh.

Gas-Storage of Fruit

FIVE coolers, specially made to complete the equipment of the experimental refrigerated chambers at the Ditton Laboratory of the Department of Scientific and Industrial Research, were presented to the Laboratory on July 5. Three of the coolers were given by Mr. S. W. Mount, of Patricksbourne, Canterbury, on behalf of a number of British fruit-growers who are owners of gas-stores; the other two by Lord Dudley Gordon on behalf of Messrs. J. and E. Hall, Ltd., refrigerating engineers of Dartford, by whom the coolers were designed and made. Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, in accepting the gift on behalf of the Department, said that it indicated the confidence of those concerned in the fruit-growing industry in the work of the Department.

IN the course of his remarks Sir Frank Smith said that English apples do not do so well in cold storage as those from some other parts of the world; they are liable to rapid wastage on removal from store as the direct result of exposure to the low temperature. Fortunately, the Department has been able to find a solution of this difficulty, namely, 'gas-storage'. At a temperature of 41° F., with the oxygen in the atmosphere reduced to 10 per cent, and with the carbon dioxide raised proportionally to 10 per cent—a result which can be simply achieved by controlled ventilation in a gas-tight store—the Bramley's Seedling can be kept in first-rate condition for so long as twelve months. The first commercial gas-store in Great Britain was built by Mr. Mount in 1929; to-day there are some forty gas-stores in operation with a total capacity of about 400,000 bushels. Gas-storage as a method of preserving fresh fruit is only in its infancy. During the 1934–35 season, home-grown pears, of the variety Conference, were kept in gas-storage at the Ditton Laboratory for some months, with highly promising results. The Laboratory has also carried out preliminary experiments on the gas-storage of tomatoes, and again the results have been sufficiently promising to warrant development.

Conference on Folk-Dancing

A CONFERENCE on folk-dancing, which is being held in London on July 15–20 in connexion with an International Folk-Dance Festival, will afford an exceptionally favourable opportunity for the comparative study of this survival of European folk art and ritual. Students from all parts of Europe, it is stated in a preliminary announcement by a correspondent of *The Times* in the issue of July 6, will be present, and will discuss selected and especially significant dances still found among the peasantry of the remoter parts of Europe. These will be illustrated in many instances by dancers of the country of origin, who are attending the conference

specially for the purpose. Thus Roumania will be represented by the seasonal hobby-horse dance performed by the Cališari with their heavy bells. The dance and its numerous seasonal parallels in other parts of Europe will be demonstrated and discussed by Prof. Vula. A Bulgarian theme, the 'spring maiden' of folk dance and song, will be analysed by Mme. Raina Katzarova, of the Ethnographical Museum, Sophia, who will illustrate her argument with movements by Bulgarian dancers. The interesting form of the sword dance found in Piedmont, with its singular combination with the maypole ritual and its resemblances in detail to the sword dance of Britain, will also be shown and afford an opportunity for comparison with a presentation of the Austrian sword dance, which has given evidence for an alternative explanation of the dance to that generally accepted. Britain, the Netherlands, France and Norway are among other countries providing material for discussion. The international folk-dance festivals which have been held in London in recent years have provided much interesting material for consideration, but on this occasion the conjunction of a conference dealing with study of the rituals, of which the dances preserve the evidence, should do much to advance the scientific study of this important department of primitive religion. The Conference will meet at the Cecil Sharp House, Regent's Park, London, N.W.1.

North East Coast Institution of Engineers and Shipbuilders

THE North East Coast Institution of Engineers and Shipbuilders will celebrate its jubilee on July 16–19 at Newcastle-on-Tyne. The Institution held its inaugural meeting on November 28, 1884, and from then until the present time has been one of the most active bodies concerned with the advancement of the sciences of engineering and shipbuilding not only in Great Britain, but also throughout the world. Representatives will attend the meeting from the leading British kindred societies and allied bodies, and also from France, Germany, Holland, Italy, Japan and the United States. The papers to be presented at the meeting will deal with the history of engineering during the past fifty years in the following sections: liners, cargo ships and tankers, coasters, marine turbines, reciprocating steam engines, marine boilers, marine heavy-oil engines, and recent progress in electrical and general engineering. Dr. John T. Batey will preside at the meetings. A pleasurable feature will be the presentation of acknowledgments to founder members. Notable among these are Sir George B. Hunter, Mr. J. Denham Christie, Prof. R. L. Weighton and Mr. W. G. Spence (the initiator and first honorary secretary of the Institution). The honorary fellowship of the Institution will be conferred upon the following: Mr. George Stephen Baker, superintendent of the William Froude Laboratory; Vice-Admiral Sir Harold A. Brown, engineer-in-chief of the Fleet; Sir Cecil Algernon Cochrane, chairman of Armstrong College Council, 1923–35; and Sir Arthur William Johns, director of naval construction.

Ultra-Violet Transmitting Glass

SPECIMENS of ultra-violet transmitting plate glass produced by Messrs. Pilkington Brothers Ltd., of St. Helens, Lancashire, show a region of high transmission in the region near 3650 A., with an almost complete opacity to the visible spectrum except in the extreme violet, where the transmission is, however, said to be only about 1 per cent. Tested with a powerful spark source and a monochromator, the claims of the makers were found to be justified. The transmission in the ultra-violet was comparable with that of an 'ultra-violet' glass from another source, the cadmium line near 3610 A. being freely transmitted; but whereas Messrs. Pilkington's new glass showed no transmission in the visible region when tested with a pocket spectroscope, the other glass showed a marked transmission band in the red. The glass can be manufactured in large sizes; specimens have been submitted of thickness 8 mm. and 11 mm. respectively. In view of the increasing importance of fluorescence tests, and other applications of ultra-violet radiation, numerous uses should be found for it, since its opacity to visible radiations should facilitate the distinction between genuine fluorescence and effects of reflected light. It may be worth noting that in very thin layers this new glass is of a blue-green colour. A prism of small angle ground to a very thin edge should make a very pretty example of dichromatism.

Scent and the Weather

HITHERTO, success in hunting has depended largely on popular omens of hunting conditions and on the practical experience of Masters of Hounds. The relation of scent and the weather formed the subject of a recent scientific study (see NATURE, April 14, 1934, p. 548). Now a meteorological officer of the Royal Air Force (R. G. Veryard) has supplied information enabling the Master to arrange place and time of meet to fit in with the best scenting conditions. In a pamphlet issued by the Masters of Foxhounds Association of India (Lieut.-Col. C. J. R. Turner, 47th Sikhs, Chaman, Baluchistan. 3 rupees), although specially written for the Peshawar Vale Hunt, he discusses many points which are of more than local interest. An inversion, or low lapse-rate of temperature, involving a restriction of the upward motion of eddies, is mainly favourable for good scenting conditions. The author does not agree with Mr. Budgett's view that for scenting conditions to be good the ground must always be warmer than the air, because a superadiabatic lapse-rate near the ground causes atmospheric turbulence which dissipates even scents which were quite strong initially. The number of good and bad scenting days are approximately equal during a calm, but, with a moderate wind, up to 3 on the Beaufort scale, the rate of evaporation is increased and scent may be good. If the air is less than 30 per cent saturated, scenting conditions are likely to be poor. Scent is more likely to be good if the soil is moist than if it is dry. The best hunting conditions in Peshawar obtained when the air temperature registered between 40° and 65° F.,

that is, in the morning. A general survey of meteorological conditions over the hunting season undoubtedly resulted in better sport, scenting conditions being predicted with fair accuracy for particular days. It is suggested that, from a study of the meteorological elements in relation to scent, a Master of Hounds will be able to frame suitable questions, the replies to which will give him a good idea how he can benefit by the information.

Micro-Climatology

A NEW quarterly journal entitled *Bioklimatische Beiblätter der Meteorologischen Zeitschrift* made its appearance last year. It is a joint production of the German and Austrian Meteorological Societies, and is edited by Drs. W. Schmidt of Vienna and F. Linke of Frankfort a. M. A specimen number (Band 1, Heft 3) has been received from Dr. Schmidt. It sets out to deal with observations made in such a way as to represent the climates actually experienced by various living organisms; in other words, to portray the so-called micro-climates. Micro-climatology is a comparatively new subject, and one which has a scope that is great in proportion as there are innumerable problems of a biological nature to which it has some application. Among the papers in this specimen copy is one by F. Steinhauser which is a good example of micro-climatology: it is a study of the special temperature conditions which the dwellers in large towns experience out of doors, conditions which are different from those prevailing in neighbouring open country, and which are of biological importance to the people concerned. Another paper, by W. Kühnelt, deals with the general significance of climate for the animal kingdom. These are both largely surveys of work done by those engaged on those special questions; in another, by Dr. Linke, one of the editors, a brief survey is given of the pioneer work of W. F. Tyler on the psychological effects of various degrees of relative humidity combined with high temperature, founded on studies made in Shanghai, from which Tyler drew lines of equal discomfort termed 'hythers' on a temperature and relative humidity diagram.

Chemical Industry in the United States

THREE hundred years ago, there was established in Boston "a strange combination of druggist's shop, metallurgist's workroom, chemist's laboratory, and alchemist's den" which may fairly claim to have given birth to the American chemical industry. It was the enterprise of John Winthrop the younger, who at the age of twenty-five years had gone from Suffolk to Massachusetts as assistant to his father, an important Puritan leader, and governor of the Company of the Massachusetts Bay. Becoming Governor of Connecticut for a time, the son later returned to England and renewed contacts with British men of science, returning afterwards to America and resuming his public service. His medicinal prescriptions became famous; he mined for lead, tin and copper; he manufactured salt, glass and iron; he produced potash, saltpetre, alum, wood pitch and tar, and indigo; he built up the first scientific library in America; and he promoted the first American chemical stock company. In celebration of the tercentenary, the American journal *Chemical Industries* has published a supplement entitled "Chemical Industry's Contribution to the Nation: 1635–1935", a pleasantly presented and lavishly illustrated issue of 176 pages, which surveys the progress of chemical industry in the United States and includes a list of important commercial chemicals manufactured in that country. The chapter describing the *raison d'être* and public service of the Chemical Foundation opens with the following statement: "The establishment of a self-contained synthetic organic chemical industry in the United States is the only thing of substantial value which we got out of the war. Its establishment meant more to the American people than reparations or territory. . . . The value of this industry to the American people is inestimable."

International Broadcasting Union

ACCORDING to a report in *World Radio* for July 5, the International Broadcasting Union concluded its annual meeting on June 26, at Warsaw. Representatives of broadcasting organisations in twenty European States and in the United States of America were present. It was stated during the course of the session that the potential audience of listeners at the beginning of June has reached at least 200 millions. Among the more important business of the conference was the decision to organise a limited number of international programmes each year, in the form of discourses in which direct contact will be established between the greatest contemporary leaders in science and art, and listeners in the various countries of the Union. The progress in technical precision in broadcasting stations in recent years is illustrated by the results obtained at the Union's central observation laboratory in Brussels. Whereas ten years ago stations were known to fluctuate a few thousand cycles per second from their normal frequency during the course of a few hours, to-day the principal European stations do not fluctuate more than one or two cycles in a month from their established frequency, which in many cases is of the order of one million cycles per second. This meeting formally marked the conclusion of the first ten years of the Union's activities; and it witnessed also the passing from the office of president of Vice-Admiral Sir Charles Carpendale (a controller of the B.B.C.) who has been president of the Union since its foundation. Very warm tributes were paid to Sir Charles for his services in the cause of international broadcasting. The new president of the Union is M. Maurice Rambert, administrateur-délégué of the Société Suisse de Radiodiffusion.

Television in Germany

THE Berlin correspondent of *World Radio* states that although the German Broadcasting Company inaugurated its experimental high-definition television service on March 22 last, suitable receivers are not

yet available to the public, and when they are produced they will cost £30–£100 each. Both the German Post Office and the Broadcasting Company are, however, eager to provide the public with means whereby they can form an opinion of the entertainment value of the new service. Accordingly, the Post Office has opened a televiewing room in Berlin where reception is demonstrated every morning. Also, in co-operation with the German Listeners' Association, four similar rooms have been opened in other parts of the city where the public can witness the reception of the evening programmes. No charge is made for admittance, although to prevent undue crowding, tickets are issued and the attendance of each person is limited to half an hour. Thus during an evening programme of one hour and a half, three groups of 40–50 persons can have a demonstration at each centre. It is intended to extend these free facilities so that television, even in its present stage, will not be limited to the small group of persons who are financially in a position to buy apparatus.

Visibility Distance of Pedestrians

TESTS were carried out last year by the Massachusetts Highway Accident Survey with the object of finding out by actual experiment the distance at which the driver of a motor vehicle can see a pedestrian who is walking along the side of a highway at night. The tests are analysed and discussed in a paper by P. Moon and R. C. Warring (*J. Franklin Inst.*, March). The principal conclusions arrived at are that the visibility of a pedestrian walking along a highway at night is increased by roughly 50 per cent by showing a small area of white such as a handkerchief. Three reflector buttons, such as those employed in reflecting type highway signs, worn with dark clothing increase the visibility distance by 100 per cent, the same as that produced by a large area of white. It was found that the maximum safe speed at night was approximately 30 m.p.h., but if there was no glare from passing cars it was 40 m.p.h. These speeds are the optimum values. The time lag of the driver seems to vary between 0·5 sec. and 1 sec. even when the surprise element is lacking. On unlighted roads the type of the pavement and the speed of the car have little effect on the visibility distance. The tests show that it is advisable not to have the candle-power of the headlamps less than 32. Experience shows that depressing the headlamp beams so as to diminish glare reduces the visibility distance. Another important conclusion is that highway lighting does not increase visibility distance unless the average luminosity of the pavement is above the chromatic threshold, which is generally taken to be of the order 0·05 lumen per square foot.

The *Camionale* Genoa-Serravalle for Lorry Traffic

THE handling of the large import and export traffic of Genoa is a problem that has been studied by many Italian Governments. A satisfactory solution has now been found. A full description of the first section of the new motor road for heavy lorries (*camions*) called the *Camionale* is published in *Engineering* of June 28. The electrification of the railway from Genoa to Roneo over the Giovi mountain range in 1916 increased the capacity of the line more than four times. When this proved insufficient, a more direct electric railway was projected between Genoa and Arquata, necessitating the construction of a tunnel ten miles long through the Giovi mountains. The development of motor road transport and the success of the *autostrada* connecting Milan and Como, Naples and Pompeii, etc., created a new situation. The autostrada are characterised by the absence of practically all crossings and have minimum gradients and curves of long radius. No pedestrians are allowed on them. The new motor road, or Camionale, will ultimately join Genoa with Milan and Turin, and the projected electric railway has been abandoned. The Camionale starts from a large square near the Port of Genoa and traverses the Promontorio and Belvedere Hills by means of two long tunnels. After passing through many further tunnels, the road passes over the Montanesi torrent by means of a picturesque viaduct. In the Littorio tunnel, 2,926 ft. in length, the road reaches its highest altitude, 1,255 ft. above sea-level, at a distance of 13 miles from the terminal square at Genoa. The terminus at Serravalle Scrivia is 31 miles distant from Genoa. The geological conditions made the construction of the Camionale very difficult. The width of the road is 10 metres (32 ft. 10 in.). The total cost of construction of the Camionale is about 3½ million sterling at the present rate of exchange.

Australian Institute of Agricultural Science

IN January 1935 the Australian Institute of Agricultural Science was inaugurated, with Prof. A. E. V. Richardson, of the Waite Institute, as its first president. The presidential message states that "the major work of the Institute will be the development of an *esprit de corps* among the members of the profession throughout the Commonwealth, and in assisting in the formation of a public opinion which will insist that the agricultural and pastoral resources of Australia should be developed by the best known methods and utilised to the best advantage attainable". The constitution provides for periodical meetings of the Institute and its local branches, and also for the publication of a journal of which the first number has now appeared (vol. 1, No. 1, March 1935). It is intended that this journal shall be devoted to the publication of leading articles, reviews of present states of knowledge, research papers, technical notes and other items of a professional and general nature. The current number gives some indication of the wide field of interests it is proposed to cover. Contributed articles deal with agricultural science in the Soviet Union, and with rural relief and agricultural extension. The economic side is catered for by an article dealing with commerce and agricultural research and also by abstracts of a discussion on "Plant Quarantine" at the Melbourne meeting of the Australian and New Zealand Association for the Advancement of Science. The technical notes deal with various problems in agricultural plant physiology, entomology and pathology, while a column of

personal notes will help to keep the members of the Institute in touch with one another. If the present programme is continued, both the Institute and the *Journal* should help to fill the need that has long been felt for an organisation, commonwealth in scope, through which the views of the agricultural profession can be expressed.

Monographs of Physiology

THE rapid advance in our knowledge in every branch of scientific inquiry makes it difficult or impossible for investigators to follow the work which is being carried out in other fields than their own in any great detail. Even in their own particular sphere, they must rely for their knowledge of the literature to a certain extent upon the abstract and review journals. For this reason, we welcome the short monographs on different subjects which are now being published in Paris: the earlier series dealt with problems of physics and physical chemistry, but during the past year various monographs on physiological questions have been issued (Actualités Scientifiques et Industrielles. Nos. 113, 135 and 136, 178 and 179. 1934. Paris: Hermann et Cie). No. 113 in the series, by T. Cahn and J. Houget, gives a short account of the biochemistry of muscular contraction. The four chapters deal with the chemical changes occurring in a muscle extract, in an isolated muscle and in the intact animal during muscular work: the fourth summarises our knowledge. There are no references. Nos. 135 and 136, by Z. M. Bacq, give short accounts of sympathicomimetic substances and of the hormones and vitamins: bibliographies are included. The first gives a brief account of substances which produce the same, or similar, effects in the body as stimulation of the true sympathetic nerves, and discusses their mode of action. The second reviews briefly our present knowledge of the hormones and vitamins, especially from the point of view of the minuteness of the quantity which is active in the body. Nos. 178 and 179, by F. Kayser, deal with the biochemistry and physiology of creatine and creatinine, including their metabolism in health and disease. The subject is treated more fully than in the other monographs and the bibliography occupies about one third of each volume. Each gives an excellent review of our present knowledge of the functions of these compounds in the body, and is worth perusal by those interested.

University Degrees in Engineering

THE series of articles in the *Engineer* on "University Degrees in Engineering", to which we directed attention some time ago, have now been republished as a booklet (London: Morgan Brothers (Publishers), Ltd., 1*s*.). The author of the articles is Dr. T. W Chalmers, and the survey has been prepared from information contained in official publications of the nineteen universities of Great Britain and Ireland. The survey does not pretend to cover all the essential features of the regulations, and matters connected with matriculation and entrance examinations have been excluded. The booklet should prove of use to everyone interested in engineering education.

Rabies in South Africa

IN the *Onderstepoort Journal of Veterinary Science and Animal Industry* for October 1934 (3, No. 2, p. 335), attention is directed to the increase in South Africa in the incidence of rabies in 1933 over 1932. The disease occurs, and appears to be spreading, among the small wild carnivora (*Viverridæ*). The disease was definitely proved in twenty animals, and in addition nine calves and three cows almost certainly died from it. There were six cases in man, transmitted once by a dog, twice by the domestic cat, once by a wild cat, and twice by the yellow mungoose (*Cynictis*).

The Case for Vivisection

AN article with this title, by a 'layman', Mr. J. Alderson, appears in the Research Defence Society's journal the *Fight against Disease* (No. 2, 1935). The author points out that experiments on animals in Great Britain are rigorously controlled by Act of Parliament; but it is his conviction that were there no such Act, vivisection would be carried out just as humanely as it is now, for a love of animals and abhorrence of wilful cruelty are as evident among medical men as among other citizens. He concludes by stating that he feels he must support and defend the work on account of the discoveries made through experiments on animals, and that whenever relevant information can be so obtained, it is our duty to encourage and support it.

Nutrition Research at the Mellon Institute

DURING 1934, Dr. Gerald J. Cox and Miss Mary L. Dodds, working on a fellowship at Mellon Institute of Industrial Research, investigated fundamental causes of tooth decay. Their work suggested the existence of a factor which, if present in the diet during a critical period of tooth formation, will aid in the construction of teeth resistant to decay. This research is to be continued, along broad lines, through a grant for a period of one year from the Buhl Foundation of Pittsburgh. The investigation, which will be known as the Institute's multiple fellowship on nutrition, will be carried on by Dr. Cox as senior fellow, Miss Dodds as the junior incumbent, and W. E. Walker as the assistant, in the Department of Research in Pure Chemistry of the Institute. It is planned first to determine definitely whether or not this factor actually exists, and, if so, its nature, properties, distribution and extraction. Secondly, studies will be made of physiological processes which are likely to influence the development of dental caries.

Award for Research in Fruit Growing

IN 1920 Miss L. Jones-Bateman of Cae Glas, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick Vase, to be used for the encouragement of fruit production. It has accordingly been decided to offer it triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, and it is available for award in 1935. Candidates

should submit accounts of their work by October 31. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years. Further particulars may be obtained from the Secretary, Royal Horticultural Society, Vincent Square, Westminster, S.W.1.

Rockefeller Medical Fellowships

THE Medical Research Council announces that the following awards of travelling fellowships for the academic year 1935–36 have been made on behalf of the Rockefeller Foundation of New York: Dr. D. F. Anderson, professor of midwifery and gynæcology, Anderson College of Medicine, Glasgow; Mr. N. R. Barrett, demonstrator of anatomy and chief assistant to the Surgical Unit, St. Thomas's Hospital, London; Mr. A. C. P. Campbell, clinical tutor in medicine, Royal Infirmary, Edinburgh, and assistant lecturer, Department of Pathology, University of Edinburgh; Mr. D. H. K. Lee, Sharpey Scholar, Department of Physiology, University College, London; Mr. J. E. A. O'Connell, demonstrator in anatomy, St. Bartholomew's Hospital Medical School, London; Mr. R. Walmsley, assistant in anatomy, University of Edinburgh. All the fellowships awarded this year are tenable in the United States.

International Medical Post-Graduate Congress

THE seventh International Medical Post-Graduate Congress of the Tomarkin Foundation, New York, which has been organised under the auspices of the Université Libre de Bruxelles, will be held at Brussels on September 12–19 and at Spa on September 20–October 2. The proceedings at Brussels will include an international commemoration of Pierre Curie and Mme. Curie by a discussion on cancer, in which the Tomarkin Foundation will be assisted by the International Union against Cancer, and communications on tropical, subtropical and infectious diseases, and neurology; while the Spa meeting will be devoted to diseases of the cardio-vascular system and diseases of the blood. Papers on miscellaneous topics will be read at both meetings. The subscription terms are as follows: Full Congress, 80 belgas; half Congress, (Brussels or Spa), 50 belgas; single section, 30 belgas. On termination of the Congress, a visit will be paid to the principal Italian universities (Milan, Pavia, Bologna, Florence and Rome) and the most important sanitary institutes. The tour will last 10–12 days and the inclusive fare will be about 1,500 lire. Further information can be obtained from the Secretary, Tomarkin Foundation, 97 rue aux Laines, Bruxelles.

Announcements

PROF. JEAN LEPINE, Dean of the Lyons Faculty of Medicine, has been elected a member of the French Academy of Moral and Political Sciences.

THE Secretary of State for the Colonies has made the following appointments: Mr. J. M. Taylor, to be chief fruit inspector, Palestine; Mr. A. H. Weir, senior assistant conservator of forests, to be assistant deputy conservator of forests, Nigeria; Mr. A. E. Colman-Doscas, agricultural field officer, Federated Malay States, to be State agricultural officer, Johore; Mr. J. C. Nauen, horticulturist, Bermuda, to be assistant curator, Gardens Departments, Straits Settlements; Mr. R. O. Williams, assistant director of agriculture, Trinidad, to be chief horticultural officer, Palestine.

THERE are at present fourteen different localities in the Soviet Union for squadrons of sanitary aviation, and their number will be considerably increased in the course of the year. The Moscow squadron which was established in the spring of 1934 has already flown 534 hours and covered 67,680 kilometres in transporting 28 sick or wounded persons, 34 doctors, 48 litres of blood for transfusion and 500 kgm. of medical apparatus.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A probationary assistant lecturer in mathematics in University College, Bangor—The Registrar (July 15).

A lecturer in mechanical and civil engineering in the Technical College, Sunderland—The Chief Education Officer, Education Offices, 15, John Street, Sunderland (July 16).

A resident tutor (male) in geography at the Borough Road College, Isleworth—Principal (July 17).

A junior forestry inspector in the Department of Lands, Irish Free State—Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (July 18).

A teacher with qualifications in zoology, botany and chemistry in the Northampton College of Technology—Secretary, Education Office, Northampton (July 18).

An assistant teacher of mining subjects in the Doncaster Technical College—Secretary, Education Offices, Doncaster (July 19).

A woman lecturer in mathematics and biology or geography in the Swansea Training College for Women—The Director of Education, The Guildhall, Swansea (July 19).

An assistant to the secretaries of the Institution of Professional Civil Servants—Honorary Secretary (July 20).

Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty and H.M. Naval Establishment—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (July 31).

An assistant lecturer in physiology in University College, Cardiff—The Registrar (Aug. 31).

An assistant in the Department of Mechanical Engineering, Guildford Technical College—The Director.

An assistant lecturer in civil engineering in the Battersea Polytechnic, London, S.W.11—The Principal.

An inspector of machinery in the Mines Department of the Gold Coast Government—Crown Agents for the Colonies, 4 Millbank, S.W.1, quoting M/3793.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 71.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Quantum Mechanics and Physical Reality

IN a recent article by A. Einstein, B. Podolsky and N. Rosen, which appeared in the *Physical Review* of May 15, and was reviewed in NATURE of June 22, the question of the completeness of quantum mechanical description has been discussed on the basis of a "criterion of physical reality", which the authors formulate as follows: "If, without in any way disturbing a system, we can predict with certainty the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity".

Since, as the authors show, it is always possible in quantum theory, just as in classical theory, to predict the value of any variable involved in the description of a mechanical system from measurements performed on other systems, which have only temporarily been in interaction with the system under investigation; and since in contrast to classical mechanics it is never possible in quantum mechanics to assign definite values to both of two conjugate variables, the authors conclude from their criterion that quantum mechanical description of physical reality is incomplete.

I should like to point out, however, that the named criterion contains an essential ambiguity when it is applied to problems of quantum mechanics. It is true that in the measurements under consideration any direct mechanical interaction of the system and the measuring agencies is excluded, but a closer examination reveals that the procedure of measurements has an essential influence on the conditions on which the very definition of the physical quantities in question rests. Since these conditions must be considered as an inherent element of any phenomenon to which the term "physical reality" can be unambiguously applied, the conclusion of the abovementioned authors would not appear to be justified. A fuller development of this argument will be given in an article to be published shortly in the *Physical Review*.

N. BOHR.

Institute of Theoretical Physics,
Copenhagen.
June 29.

Isotopic Constitution of Palladium and Gold

THESE two elements are among the few from which positively charged atoms have not been obtained by means of volatile compounds introduced into the electrical discharge or by means of anode rays. In a letter in NATURE[1], the possibility of using the ions from a high-frequency spark was pointed out. With the mass-spectrograph [recently described in NATURE[2]] it was found that palladium consists of six isotopes with atomic masses 102, 104, 105, 106, 108, 110. They could be compared with doubly-charged platinum and gold atoms which were present as a slight impurity. The four middle components are about equally strong; the one at 110 is weaker, and the lightest at 102 is the faintest.

From its atomic weight 197·2 and the behaviour of other elements of odd atomic number, it was anticipated that gold would have two isotopes at 197 and 199, one about ten times the intensity of the other. It was somewhat of a surprise to find that no second component could be found. Exposures were made with 300 and 500 times the time required to show the main line, and failed to show any trace of a heavier isotope. It is thus very probable that gold has only one component, and that the accepted atomic weight is too high.

A. J. DEMPSTER.

University of Chicago.
June 12.

[1] NATURE, 135, 542; 1935.
[2] NATURE, 135, 993; 1935.

Platinum Isotopes and their Nuclear Spin

Using a water-cooled hollow cathode of a new design, the hyperfine structure of the arc lines of platinum λλ 3408 and 3042 A. have been studied. These two lines have a common lower level $5d^9 6s^2 a^3F_4$; and the similarity of their structure patterns leads to the conclusion that in neither case is the upper level split. The lines have the following structure:

Wave-length (in I.A.)	Classification[1]	Structure (in cm.$^{-1}$)
3408·13	$5d^9 6s^2\ a^3F_4 - 5d^9 6s6p\ z^3D^0_4$	+ 0·161 (5), 0·000 (18), − 0·086 (7), − 0·176 (1), − 0·314 (4). (vide Fig. 1)
3042·75	$5d^9 6s^2\ a^3F_4 - 5d^9 6s6p\ z^3G^0_5$	+ 0·162 (5), 0 000 (18) − 0·087 (7), − 0·174 (1), − 0·314 (4).

An examination of the structure leads to the unique inference that the three central components 0·000 (18), − 0·086 (7) and − 0·176 (1) have to be ascribed to the even isotopes 196, 194 and 192 respectively, the remaining two components being due to the odd isotope 195 with a nuclear spin of $\frac{1}{2}h/2\pi$. The centre of gravity of the latter components falls at − 0·050 cm.$^{-1}$ between the bright components due to 196 and 194. The deeper level $5d^9 6sa^3D_2$ shows no measurable isotopic displacement. The hyperfine levels in platinum are inverted. These results are confirmed by the analysis of eight other arc lines of platinum, namely, 2998, 2929, 2734, 2719, 2705, 2702, 2659 and 2650 A. Neglecting

isotopes of small abundance, the isotopes of platinum, purely from hyperfine structure data, in decreasing order of their relative abundance, are 196 (18), 195 (9), 194 (7) and 192 (1). The relative isotopic abundance given above is from eye-estimates of the intensities of the components and is to be checked by microphotometric measurements.

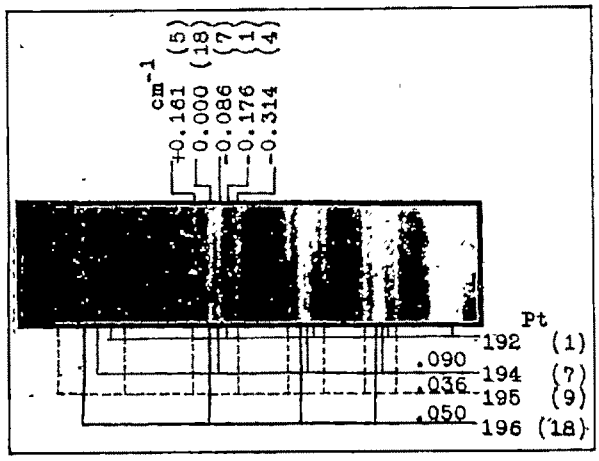

FIG. 1. Structure pattern of Pt I λ 3408·13 A. ($a^3F_4 - z^3D^0_4$) obtained by a Hilger quartz Lummer plate, 3·45 mm. thick and 20 cm. long.

Platinum exhibits a positive isotope shift, that is, the heaviest isotope lies deepest. The nucleus of platinum can be considered as having 39 α-particles, with neutrons to make up the mass number. The observed positive isotope shift is consistent with our previous generalisation[2] that even atomic number "elements whose nuclei contain an odd number of α-particles exhibit positive isotope shift and those with even number a negative displacement".

Details will soon appear in the *Proceedings of the Indian Academy of Sciences*.

B. VENKATESACHAR.
L. SIBAIYA.

Department of Physics,
University of Mysore,
Central College,
Bangalore.
June 8.

[1] Livingood, *Phys. Rev.*, 34, 185–198; 1929.
[2] Venkatesachar and Sibaiya, *Proc. Ind. Acad. Sci.*, 1, 8–13; 1934.

Selective Absorption of Slow Neutrons

IN our letter of April 12[1], we mentioned that the absorption of slow neutrons by iodine was apparently greater when the induced β-ray activity of an iodine detector was used as a measure of the number of neutrons transmitted than when detectors of silver or rhodium were employed. We have now confirmed this selective absorption and have extended the measurements to absorbers of silver and of copper, where analogous though somewhat less marked selectivity is found. The accompanying table shows the activity (expressed as a fraction of that obtained in the absence of the absorber) when hollow cylinders of silver (1·0 gm. cm.$^{-2}$), copper (4·5 gm. cm.$^{-2}$) and iodine (2 gm. cm.$^{-2}$) were placed in turn around various detectors, themselves in the form of hollow cylinders. A layer of cadmium, sufficiently thick to absorb nearly all slow neutrons striking it, was always placed inside each detector during irradiation, so that when the absorber was in place, neutrons reaching the detector must have passed once, and only once, through the absorber. The irradiation was performed within a 4 cm. cavity in a large block of wax, the source being at 9 cm. from the centre of the cavity. It seems clear that different nuclei prefer neutrons of different velocities.

Detector \ Absorber	Silver	Copper	Iodine
Silver (25 sec.)	0·50 ± 0·03	0·72 ± 0·04	0·85 ± 0·05
Silver (150 sec.)	0·51 ± 0·03	0·70 ± 0·04	0·95 ± 0·06
Copper (5 min.)	0·62 ± 0·05	0·72 ± 0·045	0·89 ± 0·06
Copper (10 hr.)	—	0·62 ± 0·05	0·90 ± 0·07
Iodine (25 min.)	0·72 ± 0·025	0·76 ± 0·025	0·68 ± 0·03
Rhodium (44 sec.)	0·69 ± 0·025	0·80 ± 0·04	0·91 ± 0·04
Silver (25 sec.) 'Cold' neutrons	0·41 ± 0·03	—	—

In connexion with the effect of temperature on the properties of neutrons, which we reported in our last letter and which is supported (at least as regards several elements) by recent work of Fermi and his collaborators[2], we should like it to be made clear that numerical values of the ratio of the activities induced by neutrons of different 'temperatures' are significant only with respect to the geometrical conditions of the particular experiment in question. An important factor is the thickness of the hydrogenous layer the temperature of which is altered. If this layer be thin in relation to the mean free path for *scattering* of the thermal neutrons, a new 'temperature' cannot be set up; if, on the other hand, the layer be so thick that there is a large chance that a thermal neutron will be *absorbed* in passing through it, the observed change in the induced activity will be a differential effect of the changes in absorption coefficients of the wax and of the specimen. It might be possible to obtain rough values for the free paths for scattering and absorption from observations of the temperature effects with layers of different thicknesses. The thickness of the detector may also be of great importance; for example, 'cold' (90° K.) and 'warm' neutrons were allowed in turn to fall on the *outer* surface of a hollow silver cylinder the wall thickness of which was one millimetre. No difference in the activities of the *inner* surface could be observed, though a very thin silver cylinder under identical conditions showed an increase of 17 per cent at the lower temperature. It is clear that the thermal neutrons are much absorbed in a millimetre of silver, so that with a thick specimen the increased activity is mainly confined to the outer layers.

Measurements of the ratio of the activity at 90° K. to that at 290° K. have given the following figures:

Copper (5 minute period), 1·25 ± 0·05; silver (25 sec.), 1·17 ± 0·04; iodine (25 min.), 1·10 ± 0·03.

The thickness of wax cooled was in these experiments 2·2 cm., and the geometry was otherwise slightly different from that of the earlier measurements, in which we found ratios of 1·26 and 0·84 for silver and iodine respectively. We had not previously investigated copper. The decrease which we previously found with iodine has turned out to be due to the presence of boron in the glass container. We have found, using both iodine and silver detectors.

that the absorption of slow neutrons by boron is greater for cold than for warm neutrons. A similar increase occurs in the absorption coefficient of silver, as is shown in the table, while a small increase in the absorption by cadmium has been found by Dunning and his collaborators[3].

The Radium Committee of the Medical Research Council has again most kindly given us, through Prof. S. Russ, supplies of radon for the sources used.

J. R. TILLMAN.
P. B. MOON.

Imperial College of Science
and Technology,
London, S.W.7.
June 27.

[1] NATURE, 135, 904; 1935.
[2] *Ric. Scient.*, June 1935.
[3] *Phys. Rev.*, 47, 888; 1935.

Absorption Continuum due to Quasi-Molecules of Calcium in Dwarf Stars of Type *M*

I FOUND several years ago that the dwarf stars of type *M* show a singular depression between the line λ 4227 and the *G* band. This phenomenon appears to be intimately connected with the intrinsic luminosity of the stars, and forms a criterion which can be used with low dispersion to a very faint limit in apparent magnitude. As the effect is therefore of considerable importance, I have arranged to study it more closely in slit spectra of larger dispersion by comparing a typical giant and a typical dwarf of type *M*. The stars chosen are:

Boss 3584, *gM*2, abs. mag. − 0·5 (Mount Wilson spectroscopic value),

Boss 2935, *dM*2, abs. mag. + 10·7 (Mount Wilson spectroscopic value).

The Cassegrain spectrograph on the 40-inch Grubb reflector of the Stockholm Observatory was used in the one-prism combination with a fine slit. The photographic energy curves of the two stars were obtained in great detail. The run of the observed differences between *B* 2935 and *B* 3584, when minor fluctuations due to various lines are eliminated, are illustrated in Fig. 1. The observed absorption continuum in B 2935 extends from λ 4227 in a very asymmetrical way, mainly towards long wave-lengths, and is noticeable between the wave-lengths λ 4120 and λ 4650. The results are entirely confirmed by analysis of the two stars with a slitless spectrograph of low dispersion.

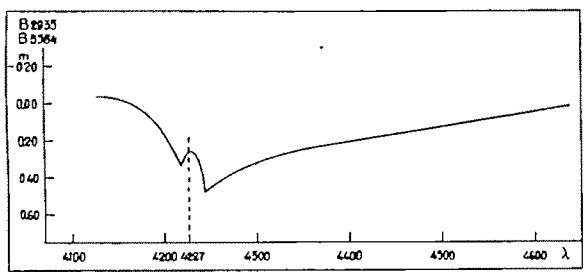

FIG. 1.

A clue to an understanding of the phenomenon is probably the continuous spectrum around the resonance line of Ca, λ 4227, which has been observed by H. Hamada[1] to extend between λ 3980 and λ 5100, and is ascribed by him to a quasi-molecule of calcium, which in the excited state consists of one atom in the $4s^1S_0$ level and one in the $4p^1P_1$ level. In our case, where the spectrum of the quasi-molecule appears in absorption, the original state should be two atoms in the ground level $4s^1S_0$. The energy of one of these atoms may be raised by absorption of a light quantum $4s^1S_0 - 4p^1P_1$, at a time when the two atoms lie close to one another. Since the polarisation effects on the potential curve are stronger in the excited state than in the unexcited state, the difference in energy between the two levels will shift from the normal value for the resonance line. The most common case of large distances between the atoms corresponds to the maximum of absorption at the resonance line itself. It is clear that the strength of the continuous absorption will be highly dependent on the average density of the Ca gas, and thereby on the gravity g at the surface of the star. We should, in fact, expect the mass coefficient of absorption at a point in the continuous spectrum of the quasi-molecule to vary in direct proportion to the density of neutral Ca gas, which with equal numbers of neutral atoms in the respective atmospheres should mean a variation proportional to g. However, the variation with g will be increased considerably by the greater number of neutral atoms of calcium in the atmosphere of the dwarf, which is evident from the behaviour of the arc lines of calcium. The values of g for the giant and the dwarf will stand in a proportion of about 1 : 4,000 to each other.

The absorption continuum in question will be largely responsible for the great intensity and marked asymmetry of the line λ 4227 when observed with low dispersion. The intensity and asymmetry increase rapidly with decreasing absolute brightness of the stars in the main series[2].

BERTIL LINDBLAD.

Stockholm Observatory,
Saltsjöbaden.
June 3.

[1] NATURE, 127, 555; 1931. *Phil. Mag.*, 12, 50; 1931.
[2] Cf. J. Ramberg, *Astron. Iakttagelser och Unders. å Stockholms Observatorium*, 11, No. 13; 1934.

Origin and Nature of the Egg Case in the Crustacea

THE origin and nature of the membranes which surround the eggs of decapod Crustacea and the means whereby the eggs are attached to the pleopods of the female have both hitherto been obscure. Herrick[1,2] gives a good review of the literature. Following up previous work (Yonge[3]) on the function of the tegumental glands in the decapods, I have found that the eggs are surrounded by two secreted membranes. The inner of these gives positive reactions to every chitin test; the outer is undoubtedly composed of the same material as the cuticle which everywhere forms the outer layer of the integument, and is secreted by the tegumental glands (for details see Yonge[3]).

The ovarian egg possesses neither of these membranes, being surrounded only by a vitelline or primary egg membrane. Eggs obtained as they left the oviduct of a laying lobster possessed only the inner, chitinous membrane. At this period the epithelial cells in the oviduct are greatly elongated and resemble the chitinogenous epithelium at the time when this is secreting new chitin: they clearly secrete this inner membrane. The so-called cement

glands, which occur in great numbers on the pleopods of the female only, and resemble in all respects the tegumental glands, secrete the outer membrane. This not only surrounds the eggs but also attaches them, by a twisted strand, to the pleopods. I have shown (Yonge[3]) that the cuticle secreted by the tegumental glands must have a very low surface tension, and this property would explain how the secretion from the cement glands wraps round the eggs and attaches these to the pleopods. Further evidence was obtained by experiments on the swelling of the eggs in various solutions, which agrees with work (unpublished) on the permeability of the uncalcified integument in *Homarus*.

Identical conditions were found in both Astacura and Brachyura, while Miss M. L. Mawson, who has been working under my direction, finds similar conditions in *Chirocephalus*. Here also the oviduct secretes a thin chitinous membrane, while unicellular glands opening into the uterus add a rugose coat giving the major reactions of the cuticle. Here the eggs are not attached but the restricted permeability of the cuticle, chitin alone being freely permeable (Yonge, unpublished work), is probably of supreme importance in protection. The presence of the cuticle will also permit of hatching by osmotic forces (see Needham[4] for literature).

Conditions in the Insecta provide an interesting parallel. Wigglesworth[5] has shown that in *Rhodnius* the integument consists of an epicuticle, closely resembling the cuticle of the Crustacea, and an underlying endocuticle which is chitinous. But both are formed by the epithelium, the dermal glands secreting the exuvial fluid (the function of which is performed by wandering cells in the decapods, Yonge[3]). Wigglesworth suggests that the cenocytes synthesise some of the non-chitinous constituents of the integument, and it seems probable that they are at least analogous with the tegumental glands of the Crustacea. They persist in the adult but are active only in the female, when he further suggests they form the material of the exclusively non-chitinous egg-case, which is probably similar to the outer membrane of the Crustacean egg.

Tegumental glands in the Arthropoda are organs of the greatest importance. In the Decapoda alone they secrete the cuticle, the protective and/or cementing membrane of the egg, and the material which secures the statoliths (Lang and Yonge[6]). They are being extensively investigated in this laboratory.

C. M. YONGE.

Department of Zoology,
University,
Bristol.
June 21.

[1] Herrick, *Bull. U. S. Fish. Comm.*, 15, 1; 1896.
[2] Herrick, *ibid.*, 29, 149; 1911.
[3] Yonge, *Proc. Roy. Soc.*, B, 111, 298; 1932.
[4] Needham, "Chemical Embryology", Cambridge, 1931.
[5] Wigglesworth, *Quart. J. Micr. Sci.*, 76, 269; 1933
[6] Lang and Yonge, *J. Mar. Biol. Assoc.* (in the press)

The Chromosome Micelle and the Banded Structure of Chromosomes in the Salivary Gland

GREAT interest has been aroused in cytological circles by the discovery that individual chromosomes in the salivary glands of *Drosophila*, *Sciara*, *Chironomus* . . . may be characterised by successions of light and dark bands and regions which are arranged in definite patterns[1].

I have recently made suggestions[2,3] as to the molecular structure of chromosomes, being guided as regards material by the behaviour of chromosomes in the mitoting cell and the requirements of genetics, as regards treatment by our present knowledge of the structure of coarse animal and vegetable fibres[4]. It is interesting to notice that the molecular structure postulated provides also a simple explanation and interpretation of the banded structure of these giant chromosomes.

The chromosome has protein and nucleic acid constituents. I locate the genetic identity of a chromosome in its characteristic protein constituent and define the *protein pattern* of an individual as a sequence of protein molecules of the classical type—peptide linked amino acids—

$$\ldots \mathrm{NH.CO.CH}P\mathrm{.NH.CO.CH}Q\mathrm{.NH.CO.CH}R\mathrm{.NH} \ldots$$

placed end to end in salt linkages. The protein pattern may therefore be expressed in terms of side chains . . . PQR . . . and in the most general case of n molecules end to end may be written in the form of a sequence of sequences of units

$$A_1B_1C_1 \ldots X_1Y_1Z_1,\ A_2B_2C_2 \ldots\ldots\ldots,\ X_nY_nZ_n \quad (1)$$

The essential requirement of genetics—that 'genes' form a linear array—is thereby met, and interpreted: the genetic identity of a chromosome resides in the nature of its protein pattern and this is expressible in a one-dimensional sequence.

To maintain this linearity of specification, we envisage the chromosome micelle, so far as the protein constituent is concerned, as an aggregate of identical sequences of molecules, the protein patterns, lying side by side. Owing to the large preponderance of basic acids in these molecules and the consequent high degree of ionisation for $p\mathrm{H} < 9$, say, these will lie on and themselves constitute a quasicylindrical surface. The molecules of nucleic acid[5], which possess four acidic centres of ionisation, for $p\mathrm{H} > 4$, say, will form salt linkages[6] with quartets of basic side chains belonging to parallel and neighbouring protein molecules. Owing to the azimuthal symmetry required by genetic considerations, the nucleic acid will polymerise in rings around the micelle. Where there are basic residues in the protein complex, there will be rings of nucleic acid; where basic residues are lacking, nucleic acid rings will also be lacking.

The Feulgen reaction, which is specific for nucleic acid, has long been recognised as a method for studying the morphology of chromosomes. For our micelle, the use of the Feulgen reaction means that attention is directed, not to the chemical nature of the chromosome in general, but only to the distribution of basic as opposed to non-basic units in the protein pattern. We are in fact considering the chromosome as characterised not by its protein pattern (1) but by what may be called its *Feulgen pattern*:

$$NNO \ldots ONN,\ NON \ldots\ldots\ldots\ldots NNO \quad (2)$$

Here N is written wherever there is a basic unit in the protein pattern, since at that point there will be a ring of nucleic acid, and O where there is a non-basic unit, since here there will be no nucleic acid.

In the salivary gland the chromosome is in a state of very considerable extension. We should therefore expect it when properly treated[7] to show up, specially favourably, the detailed alternation of basic and non-basic units in the protein pattern which characterises the individual chromosome. The salivary chromosome is a compound structure consisting of a group

cellulose. The double cellulose pattern found in coir admits at any rate of two interpretations.

The photographs, obtained after chlorination and other treatments, support the view that lignin is amorphous. The lesser intensity of the photographs may, however, have significance.

The results obtained from the wood of oak differ from those shown by the model of *Pinus* presented by Freudenberg, which, however, admits of a different interpretation, but they are probably consistent with those of Schmidt for ash and fir, and also would appear to support Pienkowski's statements (loc. cit.) concerning compact woods.

E. N. MILES THOMAS.
JOSEPH HEWITT.

Department of Botany,
University College,
Leicester.

[1] K. Freudenberg, *Der Papier Fabrikant*, **30**, 189; 1932.
[2] B. Schmidt, *Z. Phys.*, **71**, 696; 1931.
[3] S. Pienkowski, *Z. Phys.*, **63**, 610; 1930.

Registration of the Ionisation Curve of a Single α-Particle

IF an α-particle from a preparation A (Fig. 1) passes through a hole in the electrode B, it produces ions in the space between B and C. The ions drift with constant velocity in the homogeneous electric

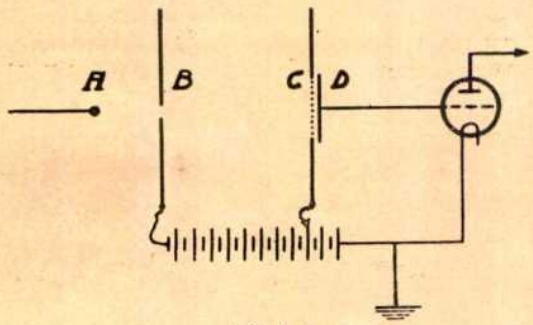

FIG. 1.

field between the electrodes. When the ion column has reached C, it passes through the meshes in the grid and produces a current $i(t)$ to the electrode D, which is connected to a four-valve amplifier. This current $i(t)$ would be expected to give a good picture

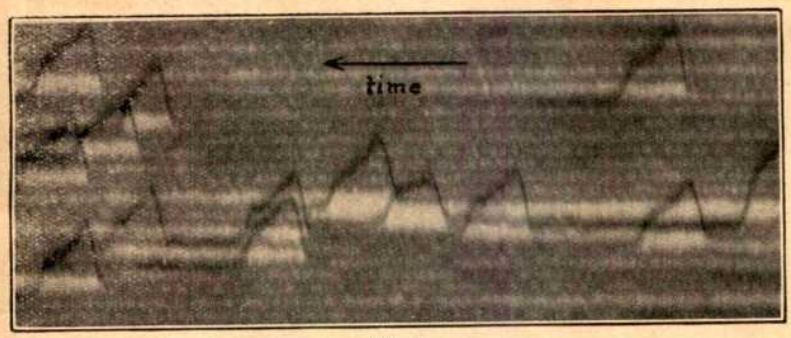

FIG. 2.

of the ionisation curve. But as D has a capacity and is well insulated, the tension to be amplified is proportional to $\int_0^t i(t)\,dt$. Therefore, in order to obtain the ionisation curve after the amplification, we must differentiate the tension curve, and this is done electrically between the third and the fourth valve by the help of a resistance-capacity device having a very short time-constant.

The amplifier is connected to an oscillograph and the light-sensitive film or paper is placed on a rotating cylinder. The zero position is moved during the revolutions.

Fig. 2 shows an oscillogram obtained in this way. The α-particles which have depicted their ionisation curves in it, came from a very weak polonium preparation placed 2 cm. from B, so that the ionisation curves represent the last 2 cm. of their path.

It seems quite possible to register H-particles in the same way. Then, if the oscillogram is calibrated, it tells us at once the kind of the particle (height of the ionisation curve) and the length of its track (proportional to the length of the ionisation curve). Therefore, if the ionisation chamber is given a geometrical form adapted for very weak preparations, this instrument may be useful for the study of nuclear reactions.

A more detailed report will appear shortly.

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May 30.

Properties of Crystalline Magnesium Oxide

ARTIFICIALLY produced crystals of magnesium oxide (MgO) are now available commercially; since they are formed as a by-product in a commercial process, they are not expensive. Our samples were obtained from the Norton Company, Worcester, Mass., U.S.A. Most of the pieces of crystal are about 1 cm. × 1 cm. × 0·5 cm., but a few larger specimens up to 3 cm. × 3 cm. × 1 cm. are produced. Some specimens are quite clear, some are slightly yellow, and some are a little cloudy. The clear specimens are transparent to λ 2200. The crystal belongs to the cubic system, but most specimens show some double refraction owing to residual strains.

Brice and Strong[1] found the crystals to be resistant to attack by lithium, sodium, potassium and calcium. We have made quantitative tests by heating the crystal with various metals in small evacuated tubes; the tubes were kept at the specified temperatures for 1 hour. Potassium (400° C.), sodium (500° C.), lead (1,050° C.), magnesium (1,100° C.), and aluminium (1,100° C.) had no effect; calcium (1,050° C.) and copper (1,100° C.) etched the surface slightly. Thus the crystal is much more resistant than glass or quartz to penetration by metal vapours. X-ray analysis shows[2] that the crystal has a close-packed structure, which probably accounts for this property.

The material can be ground and polished by using successively graded emery, tin oxide and rouge. Windows can be sealed into soda glass of high expansion coefficient. (The coefficient for the crystal is 11×10^{-6}; our glass—determined by Messrs. Yates and Roulston—has a coefficient of $9{\cdot}6 \times 10^{-6}$ in the range 0°–100° C.) The glass appears to wet the crystal when molten, and adheres well when cold, forming a vacuum-tight seal. It is important that the edges of the crystal should be polished before

of homologous chromosomes in parallel. Where there is a high density of nucleic acid associated originally with each constituent chromosome, this will show up as a dark region; where the density is less there will be a less dark region; when the density falls too low, no dark region at all will be visible.

We therefore interpret the banded structure of the salivary chromosomes as due to the alternation of basic and non-basic units in the protein pattern and as such providing a picture—though an incomplete one—of the chemical situation. This interpretation is being worked out in detail. To illustrate the orders of magnitude involved, it may be added that when the chromosome micelle is fully extended, 100 entries in the protein or Feulgen pattern represents a length of 0·035 microns and that the average number of rings of nucleic acid in the case of clupein nucleate is one per 4·9 angstroms, giving about two thousand rings per micron[8].

The fact that chromomeres seen in the early stages of meiosis stain more deeply than the intermediate regions also allows of interpretation on these lines and accords well with the suggestion recently made[3] that in the contraction of chromosomes the differential distribution of nucleic acid along the length of the chromosome plays an important part.

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June 18.

[1] T. S. Painter, *J. Hered.*, **25**, 464–476; 1934. C. W. Metz and E. H. Gay, *Proc. Nat. Acad. Sci.*, **20**, 617–621; 1934. H. J. Muller and A. Prokofieva, *C.R. Acad. Sci. de l'U.R.S.S.*, **4**, 78-83; 1934.
[2] NATURE, **134**, 978; 1934.
[3] NATURE, **135**, 788, May 11, 1935.
[4] K. H. Meyer and H. Mark, "Der Aufbau der hochpolymeren organischen Naturstoffe", Leipzig, 1930. W. T. Astbury and H. J. Woods, *Phil. Trans. Roy. Soc.*, A, **232**, 333–394; 1933. D. Jordan Lloyd, *Biol. Rev.*, **7**, 254–273; 1932. *ibid.*, **8**, 463–481; 1933.
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[6] D. Jordan Lloyd, *J. Int. Soc. Leather Trades' Chemists*, 245–258; 1933.
[7] R. L. King and H. W. Beams, *J. Morph.*, **56**, 577–588; 1934. P. Ch. Koller, NATURE, **135**, 69, Jan. 12, 1935.
[8] K. Linderstrøm-Lang, *Trans. Faraday Soc.*, **31**, 324–335; 1935.

Molecular Structure in Sisal, Coir and Oak

IN the course of an investigation on the general morphology and anatomy of *Agave sisalana*, X-ray photographs were taken in the Department of Physics, by courtesy of Dr. Leonard Huxley, of the fibres, and also of those of *coir*.

The X-ray photograph of sisal fibres (Fig. 1*a*) showed a pattern, which agrees with that obtained for cotton by other workers, and it can thus be inferred that the X-ray pattern of sisal is that of cellulose. The X-ray photograph obtained of stretched sisal fibre bears the same relation to the unstretched fibre as does the photograph of stretched cotton to that of unstretched cotton, from which it is also inferred that stretching acts on the crystallites (or micelles) in the sisal fibre in the same way as in that of cotton.

Coir was also photographed, and the X-ray pattern showed a striking difference from that of sisal, in that it consisted of two cellulose patterns at right angles to each other (Fig. 1*c*). These patterns were placed at 45° to the vertical. The coir pattern may be interpreted either as one spiral of crystallites, which runs at an angle of 45° round the fibre, or as two distinct spirals, which are at right angles to each other, but each running at 45° round the fibre and in opposite directions.

The part, if any, played by lignin has been investigated by chlorinating the lignin in the fibre by the Cross and Bevan method, and further by the removal of the lignin. No difference was shown in the X-ray pattern obtained from fibres treated in this way (Fig. 1*b*), except that the chlorinated fibres gave a less *intense* negative.

As sisal fibres have been shown to contain a somewhat low lignin component, coir fibres were chosen for comparative investigation, as containing a relatively high lignin percentage, and these similarly were chlorinated. Here, also, the photograph obtained from the treated fibres showed no difference in form from that of the untreated fibre. In both coir and sisal, however, the chlorinated fibres gave a less intense negative.

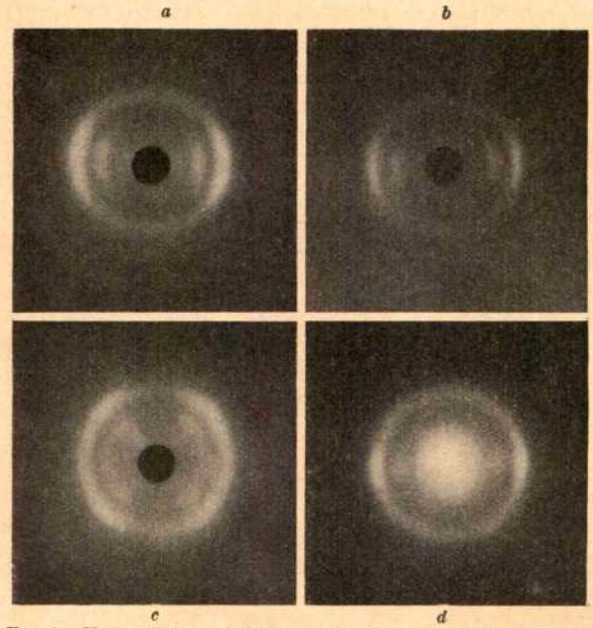

FIG. 1. X-ray photographs, taken by J. Hewitt, with fibre axis at right-angles to the X-ray beam. *a*. Sisal fibre. *b*. Delignified sisal fibre. *c*. Coir bristle. *d*. Heartwood of oak.

In a further test of the negative X-ray properties of lignin, that is, of its amorphous character, the wood of oak has been used, as having one of the highest known percentages. The photograph obtained showed, as in sisal and coir, a cellulose pattern, in which, however, the equatorial spots were sharp and not drawn out into arcs (Fig. 1*d*). It is inferred that the cellulose crystallites in oak lie parallel to the longitudinal axis of the tracheids and that they are almost perfectly orientated. This is not the case in pine wood, as illustrated by K. Freudenberg[1] in a model from the tracheids of pine. The model would suggest a photograph with two cellulose patterns at right angles to each other. The photograph of oak (Fig. 1*d*), however, agrees, to some extent, with the photographs of B. Schmidt[2] for the summer wood of ash and the spring wood of fir. Also, the almost perfect arrangement of the crystallites in oak as here recorded agrees with the statements of S. Pienkowski[3], that the cellulose crystallites are the more perfectly arranged in compact woods.

The X-ray investigations reported above show that sisal fibres have the X-ray pattern already known in cotton and therefore attributable to

sealing in. As the cutting, polishing and sealing take some time, it is desirable to select, with a polariser, specimens comparatively free from strain. With the above precautions the probability of failure is small.

We wish to thank Prof. Brice, through whose courtesy we obtained samples before the material was regularly available.

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June 21.

[1] *Bull. Amer. Phys. Soc.*, 9, No. 6, 6, Dec. 1934.
[2] W. P. Davey and E. O. Hoffman, *Phys. Rev*, 15, 333; 1920. W. Gerlach and O. Pauli, *Z. Phys.*, 7, 116; 1921.

Electrical Units and the I.E.C.

THE interesting note on Electric Units in NATURE of July 6, p. 15, is perhaps too definite in one important particular.

It is recognised that in addition to the three accepted units of length, mass and time a fourth unit is required for the specification of electrical quantities.

Prof. Giorgi, as is well known, desires the adoption of one of the International Units, and I understand prefers the International Ohm. But no decision on this point was reached at the recent I.E.C. meeting. In a letter dated June 27, 1935, and sent to me as chairman of the S.U.N. Commission of the International Union of Pure and Applied Physics, Dr. Kennelly, chairman of the Electric and Magnetic Units Committee of the I.E.C., after referring to possible quantities for the fourth unit, writes:

"It was decided that the choice should not be made before consulting the International Union of Physics S.U.N. Commission and the Comité International des Poids et Mesures Comité Consultatif d'Electricité".

He asks that the matter should be brought to the attention of the S.U.N. Commission of the International Union "as it would evidently be most regrettable if the choice and definition of the fourth fundamental and practical unit should lead in the future to incomplete agreement between the Practical Electrical Units used in Physics and in Electrotechnics".

Accordingly, I am taking steps to bring the matter to the attention of the S.U.N. Commission. A difference between the standards of the physicist and the engineer would be not merely regrettable but a disaster of the first order.

R. T. GLAZEBROOK,
Chairman of the Commission on Symbols, Units and Nomenclature of the International Union of Pure and Applied Physics.

Ballards Oak,
Limpsfield,
Surrey.
July 6.

Points from Foregoing Letters

PROF. NIELS BOHR announces his disagreement with the recently-expressed opinion by Prof. A. Einstein, B. Podolsky and N. Rosen that the quantum mechanics description of physical reality is incomplete, owing to the uncertainty principle, which states that the position and velocity of a particle cannot both be accurately known at the same time.

Using the ions from a high-frequency spark, Prof. A. J. Dempster has analysed palladium and gold by means of the mass-spectrograph. The results show six isotopes for palladium and the only one component for gold. The atomic weight of gold, if it has no isotopes, should be an integer, and the accepted value (197·2) may have to be revised.

Prof. B. Venkatesachar and L. Sibaiya identify certain components in the arc spectrum of platinum with its various isotopes (at. wt. 192, 194, 196, 195) and estimate roughly their relative abundance. As shown by the positive isotopic shift of the spectral components, the heaviest isotope lies deepest, as is generally the case in nuclei containing an odd number of alpha particles, of which platinum has 39.

Mr. J. R. Tillman and Dr. P. B. Moon find that the absorption coefficients of silver, iodine and copper for slow neutrons vary with the detector used. This indicates that the elements in question absorb selectively neutrons of different velocities. The authors also give the ratio of the activity at 90° and 290° K., and point out some of the factors that must be considered when determining the effect of temperature on the activity of the neutrons.

From the difference in the spectra of a typical giant star and a typical dwarf star (due to absorption of light in the region of wave-lengths 4100–4600 A.) Prof. Bertil Lindblad infers the presence of excited calcium molecules and deduces that the value of the gravitational constant g for the giant and the dwarf is in the ratio 1 : 4000.

The nature and origin of the membranes surrounding the eggs of the lobster and the means whereby the eggs are attached to the swimming limbs of the female are described by Prof. C. M. Yonge and compared with conditions in other marine animals.

Dr. D. M. Wrinch draws a picture of a chromosome as a sequence of protein molecules linked end to end by their acidic and basic groups, to satisfy the essential requirements of genetics that genes form a linear array. She interprets the banded structure of the salivary gland chromosome of the fruit fly as due to the alternation of basic and non-basic units in the protein pattern.

Dr. E. N. Miles Thomas and Mr. J. Hewitt describe the X-ray patterns of sisal, coir and oak. Sisal gives the usual cellulose pattern; the coir pattern may be interpreted either as one spiral of crystallites or as two distinct spirals at right-angles to each other, running in opposite directions at 45° round the fibre. In oak, the crystallites appear to lie parallel to the longitudinal axis of the wood cells (tracheids) and are almost perfectly orientated. The effect of chlorination upon the X-ray patterns supports the view that lignin is amorphous.

An apparatus by means of which the ionisation produced by a single alpha particle or by a proton can be directly registered is described by Dr. Hannes Alfvén. It may prove useful in the study of nuclear reactions leading to atomic disintegrations.

Prof. R. W. Ditchburn and Mr. J. Harding describe some properties of crystalline magnesium oxide, which is now commercially available. The crystal can be polished and sealed into soda glass, and is very resistant to attack by metal vapours.

Research Items

Stone Age Survivals in Ireland

A MOUSTERIAN tradition surviving into the Campignian is very clearly exemplified in the industry of Rathlin Island investigated by Mr. C. Blake Whelan. The dangers of chronological assumptions based on comparative typology are here exposed on the periphery of 'neolithic' migrations. A striking example is afforded by a cordate or sub-triangular hand-axe of fine grained stone, a surface find from one of the numerous late prehistoric stations spread over the Rathlin uplands (*Antiquaries J.*, **15**, 2), to which it is highly unlikely that a date earlier than 2500–2000 B.C. can be assigned. This dating is all the more probable in the light of the results of excavation, although the survival of the use of implements of fine grained rock to at least as late as the final Bronze Age or early Iron Age (500 B.C.) admits of a much later dating. It would be difficult to find a better example than this specimen of the survival of Levallois and Mousterian technique, upon which Goury, the present writer and others have based the postulate of an eastern focus at which, uninfluenced by any Upper Palæolithic technique, the Mousterian evolved into the Campignian and, moving westward, absorbed and devised new forms which preserved the heavy aspect of the ancestral technique. The specimen under notice is a faithful reproduction of the cordate or sub-triangular hand-axe of cave Mousterian universally figured as type specimens of this epoch some sixty thousand years earlier.

Divination in Melanesia

AMONG the Tanga people, who occupy islands off the coast of New Ireland, Mandated Territory of New Guinea, great ritual importance is attached to death, and at one time a divinatory ceremony was practised when sorcery was suspected as the cause. One such ceremony, which took place long ago, has been described in detail to Mr. F. L. S. Bell by two aged men who themselves had taken part (*Man*, **90**; 1935). It was performed in connexion with the unaccountable death of a young woman. The instrument of divination was a bamboo pole, about thirty feet long, to which was attached a bunch of highly perfumed leaves, believed by the natives to be a strong aphrodisiac. The ceremony was termed "Several men fish for the ghost", and it was believed that the leaves served as bait. The pole was raised on the shoulders of five or six men, who were distant relatives of the deceased. They then carried it to the place at which the woman was born, as the most likely spot at which her ghost would be found. When the pole became heavy on their shoulders as they marched, it was believed that they had encountered the ghost. It then fled to her husband's house, whither they followed it. Twenty men then clung to the pole, headed by one of the woman's cross-cousins, who began to question the ghost. It was essential that no one within the forbidden degrees should touch the pole, otherwise the ghost would not answer. The ghost was asked who was responsible for her death, individuals being mentioned by name. When the guilty person was named the pole began to vibrate violently and was drawn towards the interior of the house, the efforts of the twenty men, however strong, being unable to prevent it. When the pole ceased to vibrate the men withdrew and the pole was placed by the side of the woman's grave. No punishment followed, except the ill-repute of being a sorcerer and consequent ostracism.

Identical Twins

IN a lecture on twins (*Eugenics Rev.*, **27**, No. 1), Dr. J. A. Fraser Roberts reviewed the modern work on this subject. He favours a genetical rather than a physiological theory of identical twinning. A quiescent phase of the embryo occurs in the badger as well as the armadillo, but in the badger identical twins are unknown. Some identical human twins show mirror-image phenomena, but this is not true of the twins that are most nearly identical. It appears that mirror-image twins are due to a somewhat later separation of the embryo into two. The intelligence quotient of identical twins is not so largely inherited as stature and other physical characteristics. Nevertheless, it is concluded that even here heredity is more than three times as important as environment. Reference is made to the studies by Newman of twins reared apart, and it is suggested that similar comparisons should be made of twins reared together. The need for more accurate records of twin births by physicians is emphasised. Psychological studies should be made of the comparative effects of training on twins, following Gesell. The ideal would be a register and 'follow up' of all twin births.

Agranulocytic Angina

THIS is a rare disease characterised by severe sore-throat or tonsillitis ('angina') with fever and prostration, and frequently fatal. It was first described in 1922 by Werner Schultz (*Deutsch. med. Wochschr.*, **48**, 1495), and a review on the subject by Dr. E. W. Adams, with bibliography, has been recently issued by the Ministry of Health (Rep. on Pub. Health and Med. Subjects, No. 76. London: H.M. Stationery Office, 1935. 6*d*. net). A remarkable and characteristic feature of the disease, from which it derives its name, is a diminution in the number of leucocytes or white blood-cells from the normal of 10,000–12,000 to 1,000 or less per c. mm. of blood, with an almost complete disappearance of the polynuclear leucocytes ('granulocytes'), which normally constitute 75 per cent of the total leucocytes. About a thousand cases of the disease have now been described, of which only twenty-two have been recorded in the British Isles. It is more common in females, and the fatality in the earlier cases was more than 90 per cent. The causation is obscure, but evidence suggests the action of some toxic agent. Much accumulated evidence points to a connexion with the use of the drug 'amidopyrine', and a case appears to have been made out incriminating the benzamine group of drugs. Dr. Adams has collected 140 cases, with 74 deaths, following the administration of amidopyrine, and two single doses of 10 grains and 5 grains of this drug have been found to cause an immediate and striking diminution in the granulocyte and total white blood-cell counts. Pentose nucleotide appears to exert a curative action, the mortality in cases treated with this agent being only 25 per cent.

New Sponges from the Puerto Rican Deep

DR. M. W. DE LAUBENFELS has described twenty-seven new species of sponges from the Puerto Rican Deep (Johnson Fund. Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Smithsonian Miscellaneous Collections, 91, No. 17. Dec. 1934). Nearly one fourth of the total number of sponges collected by this expedition were new. Many of them may have been collected and described before, but unrecognisably, because in the descriptions made more than fifty years ago very little attention was paid to those microscopic characters that to-day are considered of primary importance. All the new species belong to the Demospongiæ, and these belong to 17 families, of which 4 are new, and 26 genera, of which 11 are new. Only a few species belonging to the Calcarea (or Calcispongiæ) and somewhat more of the Hexactinellida (or Hyalospongiæ) were found, and apparently no new species of either of these two orders. A final report is in progress which will include these.

Aphid Transmission of Strawberry 'Yellow-edge' Virus

The constant association of 'yellow-edge' disease of strawberries with the presence of the tarsonemid mite (*Tarsonemus fragariæ*) led to an investigation, by Mr. A. M. Massee, as to whether the mite was a vector of this particular virus disease (*J. Pomol. and Hort. Sci.*, 13, No. 1, pp. 39–53, March 1935) which showed that this relation does not hold. The strawberry aphis (*Capitophorus fragariæ*), however, is proved to transmit the disease to healthy plants in the month of June, though there is some doubt about its ability to do so in late July and August. The tarsonemid mite causes severe damage on its own account, and frequently masks the appearance of virus symptoms.

Observations on *Sorghum*

Two short papers which have appeared in *Current Science* of February, 1935, describe "Bulbils in *Sorghum*" and "*Sclerospora* Sp. and Suppression of the Awn in *Sorghum*". The former article, by G. N. Ramgaswami Ayyangar and V. Panduranga Rao, of the Millet Breeding Station, Coimbatore, India, announces the discovery of vegetative bulbils in place of grains in a small percentage of the progeny of a cross between single-seeded and double-seeded *Sorghum*. The second paper is by G. N. Rangaswami Ayyangar and P. V. Hariharan, and describes the symptoms of attack by a species of *Sclerospora* fungus. This has the effect, among other actions, of suppressing the awns of *Sorghum*. The leaf-blade is the most susceptible part of this plant in attack by *Sclerospora*, and as the awn has been considered homologous with the leaf blade, it seems natural that the awns should be suppressed, yet curious that organs of such divergent morphology should be attacked so specifically.

Petroleum Fuels in Canada

THE Mines Branch, Department of Mines, Canada, in co-operation with the Dominion Fuel Board, has recently issued Bulletin No. 759 on deliveries of fuel oil, kerosene, gasoline and petroleum coke in Canada during the last few years. In this statistical survey, fuel oil comprises all grades heavier than 42° A.P.I.; kerosene, the white and amber grades ranging from 42° to 47° A.P.I. plus distillate oils coming within these ranges; and gasoline those grades having 55° A.P.I. or lighter as their gravity. Statistics collected are presented in the form of eight tables showing gallons of the four classes of petroleum fuels marketed in Canada and their distribution in the provinces in 1932 and 1933; the amounts of fuel oil and kerosene delivered in the provinces and a classification of their specific uses; the sales of gasoline (and motor fuel) in Canada by provinces, and finally data of petroleum coke deliveries for domestic and industrial heating. Several interesting facts emerge from these statistics. In 1933, deliveries of petroleum products in Canada for fuel purposes amounted to 945 million Imperial gallons, of which 419 were fuel oil, 42 kerosene and 484 gasoline. Of the fuel oil delivered, 27 per cent was used for domestic heating, 21 per cent for industrial heating, 3½ per cent for tractor fuel and nearly 49 per cent for locomotive and bunker fuel. Of the kerosene delivered in 1933, representing approximately one twentieth of the aggregate of petroleum fuels, 54 per cent was accounted for by domestic heating, 37 per cent by tractor fuel and 9 per cent by general uses. As regards gasoline, statistics of sales show that in 1933 approximately 88 per cent was sold for motoring purposes and 12 per cent for other general uses.

Measurement of Solar Radiation

PROFESSIONAL Note No. 68 of the Meteorological Office, by Mr. H. L. Wright, contains comparisons between readings of the following instruments made at Kew Observatory in July–November 1927: (1) the Gorczynki pyrheliometer, (2) the Campbell-Stokes sunshine recorder, (3) the black bulb thermometer *in vacuo*. Of these three instruments, only the first represents a serious attempt to deal quantitatively with solar radiation; the second allows a rough estimate to be made of the length of time during which the radiation is above the minimum required to scorch the card of the recorder; the third purports to give a measure of the maximum intensity of the solar radiation each day by recording the highest temperature reached by a specially blackened maximum thermometer in a glass-walled chamber from which, as far as possible, all air is removed. Official meteorology, in Great Britain at least, has not of late taken the black bulb thermometer seriously, and the records of this instrument do not appear in the regular official publications. Among the comparisons is a diagram showing daily totals of radiation obtained with the pyrheliometer plotted against the estimated durations of bright sunshine given by the Campbell-Stokes instrument. This shows that the average daily rate at which radiation is received at a surface normal to the sun's rays at Kew under the best conditions is 0·95 gm. cal./cm.^{2} per minute, that is, about half the solar constant. The highest instantaneous rate was 1·43 gm./cal. on September 24, 1927, in polar air behind a depression over the North Sea, with the barometer down to 985 millibars and rising briskly. Comparisons between the widths of the burns on the cards of the sunshine recorder and the associated rates of radiation give an exponential relationship, the rate of radiation being proportional to e raised to the power $0{\cdot}64\ w$, where w is the width of the burn. The recorder was found to be insensitive to radiation of less than about 0·2 gm./cal. The figures relating radiation to the black bulb

readings are of interest mainly in that they show how well founded are the official objections to the latter instrument. It appears that the maximum rate of radiation for a given black bulb maximum is much less in July and August than in October and November.

A New Theory of Atmospheric Electricity

IN a long paper, published in the March issue of *Terrestrial Magnetism and Atmospheric Electricity*, Ross Gunn develops a new theory which claims to explain the generation of electric charges in clouds as well as many cognate phenomena. The theory depends on what its author calls "some preliminary and not very well-controlled experiments . . . devised and carried out as a result of certain theoretical considerations". A small 'pill-box' of thin sheet tin was connected to an electrometer. An iron disc was reduced to the temperature of carbon dioxide snow and quickly placed inside the pill-box. As the box cooled, water condensed on the outside and the box acquired a negative potential, about $-0 \cdot 1$ volt; then, as the pill-box warmed up, condensation ceased and after a minute or two the potential became positive. Gunn accepts the experiment as sufficient demonstration that condensation produces negative electrification of the water and positive electrification of the air, whilst evaporation produces positive electrification of the water and negative electrification of the air. Other investigators have looked in vain for such results of condensation and evaporation. Gunn assumes that these processes go on in the clouds and says that when raindrops are formed in an ascending current, the drops acquire negative charges whilst the positively charged air passes up to the top of the cloud. It may be remarked that the Ross Gunn cloud, like the Wilson, would have a positive charge above, and a negative charge below. Whether clouds of this type really predominate is a question which should have been settled long ago.

The Rectifier Photocell

A RECENT article by G. P. Barnard (*Proc. Phys. Soc.*, May) gives working details of the preparation of a new selenium-sulphur photo-cell of the 'Sperrschicht' type and an account of its properties. Photo-cells of this general type are obtainable commercially, but hitherto there has been no account sufficiently detailed to allow the construction of a cell for any special purpose. The cells were made by coating iron discs with the molten selenium-sulphur mixture, annealing, and sputtering lightly with gold, silver or platinum. The heat treatment of the films is critical; the active layer consists of selenium embedded in a matrix of sulphur-selenium eutectic in which the sulphur enters the selenium lattice. Theories of the behaviour of the cells have been given by A. H. Wilson and by Frenkel and Joffé. Both theories involve the assumption that in the system metal–semiconductor–metal there is a definite gap at one of the interfaces. The experimental behaviour of the cells is rather complicated because the illuminated cell behaves as a source of E.M.F. shunted by one resistance and placed in series with another. The behaviour varies, therefore, with the characteristics of the external circuit. It is expressed in the paper by sets of curves, and compared where possible with theory. The spectral sensitivities of some of the cells were measured.

Migration of Sodium on Tungsten

R. C. L. BOSWORTH (*Proc. Roy. Soc.*, A, May 1) has investigated the mobility of adsorbed sodium atoms. A patch of alkali atoms was sprayed on to a tungsten strip as positive ions from a Kunsman filament, and the movements of the sodium were followed by exploring the strip with a sharply defined spot of light and making use of the photo-electric effect of the sodium-covered surface. It was first found that an active patch decayed with time, apparently due to a migration of sodium into the intercrystalline cracks of the tungsten. The sodium could be partly recovered by heating the strip to 1,300° K., and, after about 10^{17} atoms had been deposited per sq. cm., the strip was saturated and the surface layer remained stable. When a patch had been obtained, it was found that it spread over the surface at an appreciable rate at room temperature and more rapidly at 800° K. At the latter temperature the strip is approximately uniformly active after 5–10 seconds. The temperature variation of the diffusion process is used to obtain an 'activation energy' for the migration process. The results are interpreted by supposing that a sodium atom may take up the activation energy of about 0·25 volt and pass into a mobile state in which it can migrate for considerable distances, either over the surface or into the cracks.

Stellar Motions

IN "A Preliminary Note concerning a New Theory of the Motions of the Stars" (*Proc. Nat. Acad. Sci.*, 21, 143; 1935), J. Schilt describes what might better be called a new empirical analysis of these motions. He has first taken known rectangular velocity-components $\dot{X}$, $\dot{Y}$, Z of A-type stars, and chosen his Z-direction in such a manner that *the density of velocity-points has maximum gradient in this direction.* He then fixes attention on the Z-velocities, rather than on the velocity components in the preferential direction determined in the more usual way by use of the velocity-ellipsoid. The Z-velocity component for any star is expressible in terms of the angle between the direction of the star and the Z-axis, and the observed values of its parallax π and of its radial and proper motions. Schilt finds that it can be represented statistically as the sum of one of two constant values, and an 'expansion' term proportional to the Z-co-ordinate. The resulting relation can be solved for π, thus giving a new expression which may be used to obtain statistical parallaxes of stars from a knowledge of their velocities. The author has verified that a formula of this type is successful in a large number of cases in giving parallaxes in agreement with trigonometric values. He claims that it makes it possible to gain insight into the 'giant' part of the Hertzsprung-Russell diagram, where spectroscopic and trigonometric parallaxes are not available. He further considers that his analysis gives a better account of the distribution of radial velocity than does the 'double wave' representation suggested by the theory of galactic rotation. However, from the theoretical, as opposed to the empirical, point of view, the work must ultimately be tested in the light of some very general considerations regarding the properties of arbitrary velocity distributions, which have lately been brought forward by E. A. Milne (see *Observatory*, **58**, 167, June 1935).

Geological Survey and Museum

CEREMONIAL OPENING OF NEW MUSEUM

ON Wednesday, July 3, H.R.H. The Duke of York performed the opening ceremony of the new Museum of Practical Geology in Exhibition Road, South Kensington. A description of the building and its principal exhibits appeared in NATURE of June 29 (p. 1060).

His Royal Highness was received at the door of the Museum by the Mayor of Kensington. The official party that accompanied the Duke to the platform were: The Right Hon. W. G. A. Ormsby-Gore, First Commissioner of H.M. Office of Works, Lord Rutherford, chairman of the Advisory Council for Scientific and Industrial Research, Sir Patrick Duff, secretary of H.M. Office of Works, Mr. J. H. Markham, the architect, Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, Sir John Flett, the director of the Geological Survey, and Dr. W. F. P. McLintock, the curator of the Museum.

Mr. Ormsby-Gore, in inviting His Royal Highness to declare the Museum open to the public, said that the Geological Survey of Great Britain is the oldest national geological survey in the world. It was instituted for the purpose of preparing copies of the Ordnance Survey maps geologically coloured so as to be of service to science and industry by providing an accurate representation of the geology of Great Britain. The Museum of Practical Geology developed out of the collection by the Survey of specimens of rocks, minerals and fossils, and was first opened to the public in 1841. It was soon found that the importance of the collection warranted the erection of a building designed to display the work of the Survey and the application of geology to the arts and industry, and in the year of the Great Exhibition the building in Jermyn Street was opened by the Prince Consort. The new Museum was commenced in 1929 and was substantially completed in 1933, when it was required for the World Monetary and Economic Conference. The cost of the building was some £220,000, and a lease of the Crown site of the old premises had been granted at a rent which considerably exceeded the interest on the capital sum expended on the new building.

The Duke of York said that the new building makes a notable and welcome addition to the great museums erected on the land provided for the encouragement of science, art and industry by the wise foresight of the Prince Consort. With the Science Museum on one side and the natural history section of the British Museum on the other, it provides a suite of scientific exhibits unequalled in any other country. In 1683 the Duke of York, later James II, opened the Ashmolean Museum at Oxford, which contained the first British geological collection. In 1835, as a result of the work of Henry de la Beche, the Geological Survey was founded as the first official organisation of its kind. To-day there are more than 120 official geological surveys in different parts of the world, to many of which, and particularly those in other parts of the Empire, the Geological Survey of Great Britain has been a parent. He was glad to know that a large number of delegates from abroad had come to celebrate the centenary of the Survey.

The Museum was well filled with a large and representative gathering that included British, Colonial and foreign geologists who had been invited to participate in the ceremonies. The new Museum was much admired and it was generally acknowledged that no geological survey in the world has better offices, library and laboratories and a more satisfactory museum. Some of the directors of geological surveys took many notes of the organisation and arrangements of the exhibits, and they were particularly struck by the effort that has been made to attract the interest of the non-geological public.

On Wednesday evening, July 3, the Geological Society of London gave a reception to the foreign and Empire delegates in its rooms in Burlington House.

CENTENARY OF THE GEOLOGICAL SURVEY

On Thursday, July 4, at 11 a.m., a meeting was held in the hall of the Royal Geographical Society to celebrate the centenary of the Geological Survey of Great Britain. Lord Rutherford of Nelson occupied the chair, and was accompanied by Sir Frank Smith and Dr. T. F. Sibly, representing the Department of Scientific and Industrial Research and the Geological Survey Board.

In a brief introductory speech, Lord Rutherford commented on the great progress which the knowledge of geology has made in the last hundred years and the distinguished part which British geologists have played in furthering the growth of the science. He cited the names of William Smith, Lyell, Sedgwick, Murchison, Darwin and others as founders of geology, and expressed his thanks to the foreign, Dominion and Colonial geologists who had accepted the invitation to assist in the celebration.

The overseas and British delegates then responded to their names and were presented to the chairman.

The list of delegates is much too long to be given in full as it contains more than two hundred names, of which 85 were from foreign countries. Mention, however, may be made of a few selected names. The Belgian delegation was very representative, including Prof. Renier (Brussels), Prof. Fourmarier (Liège), Profs. Halet, Legraye, Van Straelen and Thoreau. Prof. Robert represented the Geological Survey of the Belgian Congo. From France arrived Profs. de Margerie, Jacob (Paris), Léon Bertrand (Paris), Fallot (Nancy), Dubois (Strasburg), Roman (Lyon), Besairie (Madagascar), Bétier (Algeria), Legoux (French West Africa). The German delegation was led by Prof. von Seidlitz (Director, Geological Survey of Prussia) and included Profs. Stille, Cloos, Hirmer, Angenheister and Schmidtgen. Among others present were Madsen (Denmark), Gavelin and von Eckermann (Stockholm), Laitakari (Helsingfors), Kettner (Prague), Crema (Italy), Loczy de Locz (Hungary), Morozewicz (Poland), Royo y Gomez (Madrid). The Swiss representatives were Profs. Lugeon, Buxtorf and Staub, and much interest was taken in the two Russian delegates, Prof. Ferodowsky (Moscow) and Prof. Karpinsky, the president of the

Academy of Sciences in Leningrad, who is in his ninetieth year and had flown to London, accompanied by his daughter. From the United States there came Dr. Day of the Geophysical Laboratory of the Carnegie Institution of Washington; Dr. Matthews, Johns Hopkins University, Baltimore; Profs. Rice (Harvard), Moore (Kansas), Marquis (Washington), Leith (Wisconsin), Anderson (Stanford), Leuschner (Berkeley). From Canada, Profs. Coleman (Toronto), Adams (Montreal), Atkinson (Saskatoon). Among other distinguished Empire geologists present were Grabham (Sudan), Haughton (Pretoria), Richards (Queensland), Kitson (Victoria), Pascoe (India), Lightfoot (Southern Rhodesia), Seymour (Dublin), Mellor (Johannesburg), Scrivenor (Malaya) and Raeburn (Nigeria).

Thereafter, Sir John Flett, director of the Geological Survey and Museum, gave an address on the history and functions of the Geological Survey. He outlined briefly the state of geological science in the year 1835 when the Survey was founded, and remarked on the brilliant assemblage of geologists then living in London, among whom were Buckland, Murchison, Sedgwick, Lyell, Greenough, Fitton, MacCulloch and De la Beche. Much interest was being taken in geological maps. William Smith's famous map had appeared in 1815. Greenough's map was issued in 1820. A desire for still better maps was strongly felt and with the support of Colby, director of the Ordnance Survey, a deputation of prominent members of the Geological Society of London represented to the Prime Minister the value of geologically coloured maps on the scale of one-inch to a mile. Consent was obtained and the work was entrusted to Henry de la Beche. The work began in Devon and Cornwall, spread thence to Wales and eastwards to the London district and the Midlands. By 1860 it had reached the Lancashire and Yorkshire coalfields, and in 1883 the original survey of England and Wales was finished. Simultaneously, the Geological Surveys of Ireland and Scotland had been active both in field work and in publication. De la Beche was remarkably successful in enlisting able and enthusiastic assistants, among whom Ramsay, Aveline, Selwyn, Logan and Jukes did imperishable work.

De la Beche died in 1855 and was succeeded by Sir Roderick Murchison, who was an active and efficient director. He was followed by Sir Andrew Ramsay, equally skilled in the field and with the pen, who had been De la Beche's loyal lieutenant. Sir Archibald Geikie in turn held control until the end of last century. What is known as the 'Old Series' of hand-coloured geological maps was essentially the product of the labours of the staff under these leaders. In 1901 Sir Jethro Teall took up the reins, followed by Sir Aubrey Strahan. Many improvements were made in all departments of the service and the present type of colour-printed maps was introduced.

At first under the Board of Ordnance, then under the Woods, Works and Forests, then under the Board of Trade and the Science and Art Department, soon transferred to the Board of Education, and since 1919 under the newly constituted Department of Scientific and Industrial Research, the Geological Survey and Museum has pursued an even course.

De la Beche started to exhibit geological specimens, maps, models and mining apparatus in rooms in Craig's Court about 1837. The old Museum of Practical Geology in Jermyn Street was opened by the Prince Consort in 1851. It is now in process of demolition. This furnished an opportunity to realise De la Beche's ambition to found a School of Mines resembling the famous institutions of the Continent, and in this also he was successful. After preliminary vicissitudes the School achieved a great reputation and many famous names are found in the lists of its staff. Forbes, Huxley, Playfair, Frankland, Warington Smyth, Percy, Stokes, Tyndall, Le Neve Foster, were among the professors. The men who were privileged to study under them are justly proud of their School and its great traditions.

The School of Mines outgrew its accommodation at Jermyn Street and was transferred by stages to South Kensington, where now it occupies commodious buildings adjacent to the Science Museum and the Geological Survey and Museum.

The practical applications of geology were never absent from the mind of De la Beche. He established a Mining Record Office for collecting statistics of output and plans of mines. His chemists also attacked many practical problems, such as British iron ores and steam coals for the Navy. Science was for him not a lonely virgin but the fruitful partner of industry. Could he return to-day and see how widely his influence has spread, even he might be astonished. The old collections of Jermyn Street have fertilised the Science Museum, Bethnal Green Museum, Science Library, School of Mines, Mines Department, Imperial College and the Victoria and Albert Museum. All of these contain material that can be traced to his assiduous and enterprising activities. His successors, though their energies are less widely dispersed, maintain close connexion with practical problems. Water-supply, engineering, fuel research, agriculture, mining, architecture, transport, all call for geological information and receive their due share of attention.

At the conclusion of the director's address, the chairman called upon some of the delegates to speak. Prof. Coleman (Toronto), Prof. Matthews (Baltimore), Prof. de Margerie (Paris), Prof. von Seidlitz (Berlin) and Prof. W. W. Watts (London) in turn expressed their appreciation of the work of the Geological Survey, and the services it has rendered to geological science and to the prosperity of Great Britain.

In the evening at 7 o'clock the staff of the Geological Survey and the members of the Dining Club of the Geological Society entertained the Overseas delegates and their wives to dinner at the Rembrandt Hotel. The Company numbered 220 and only two speeches were delivered. Sir John Flett as chairman proposed the toast of the guests, which was responded to by Dr. A. L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington and vice-president of the National Academy of Sciences of the United States.

Thereafter the company proceeded to Lancaster House, where a Government reception was held. The guests, numbering more than a thousand, were received by the First Commissioner of H.M. Office of Works and Lady Beatrice Ormsby-Gore.

On Friday, July 5, a series of excursions to districts of geological interest, specially conducted by officers of the Geological Survey for the benefit of those who attended the celebrations, left London. The selected localities are Edinburgh and the Forth Valley, Bristol and South Wales, and the Isle of Wight. Each excursion is to last for a week, and descriptive programmes and itineraries have been specially prepared.

Hydraulic Couplings and Torque Converters

IT is indicative of the interest being taken by engineers in the comparatively recent hydraulic method of transmitting torque and to the importance attached to its development that three papers on this subject were read during April and May before the Institution of Mechanical Engineers. Its application, as the fluid flywheel, to automobile drives has attracted to it the attention of a much wider public than the engineering profession.

Some misconception is prevalent regarding this method of transmission. While it is rightly understood that power is transmitted from one disc—the 'driver' or 'impeller'—to another quite unconnected disc—the 'runner'—by the action of the oil which is kept in circulation, it is assumed by many that the oil is enabled to do this by acquiring some quality of lateral resistance due to an extraordinary degree either of shear resistance or of viscosity imparted to it by the circulatory velocity. In fact, however, the explanation is much simpler. The 'impeller' disc acts on the oil as a centrifugal pump imparting kinetic energy to it, and discharges it into the 'runner' disc, which operates as a turbine and receives energy from the liquid. Its discharge goes back to the impeller for the next cycle of energy transfer.

In his paper "Recent Developments in Hydraulic Couplings" (*Proc. Inst. Mech. Eng.*, April 26) Mr. Harold Sinclair explains the fundamental differences between the two systems of hydraulic transmission—the displacement or hydro-static system and the turbo or hydro-kinetic system, to which latter these couplings and converters belong—and the main advantages of the turbo system. Following a brief historical survey from the pre-War speed transformers originated by Dr. Fottinger for marine turbine propulsion, he outlines the elements of the theory on which this type is based. Proceeding mainly in a descriptive and explanatory vein, the author devotes the bulk of his paper to the development of the Vulcan-Sinclair Coupling. This is a modification of the Vulcan marine type to meet the conditions of industrial and automotive service, and particulars are given of its application in three distinct forms: (1) the scoop type for constant speed motors driving variable speed machines, (2) the traction type, including the fluid flywheel, for variable speed engines and motors, and (3) the ring valve traction type for both constant and variable speed engines.

In "Voith Turbo Transmissions" (*Proc. Inst. Mech. Eng.*, May 3) Dr.-Ing. Wilhelm Hahn discusses the application of torque converters and hydraulic couplings. The former, having in addition to the two discs—the 'impeller' and the 'runner'—a stationary guide ring, is enabled to step up the value of the torque and so is capable of overcoming a high starting resistance. After examining theoretically the relationship between power, torque and speed in a torque converter and considering the conditions for maximum efficiency, he suggests that, to attain as nearly as possible to the ideal torque curve, the torque converter be used for starting up and that, at the appropriate moment, a change-over be effected to the direct drive of a hydraulic coupling.

The necessity for this change-over and the duplication it involves arises from the practical difficulty of fitting the converter with variable blades on the stationary ring so that it is adaptable to all conditions. In "Progress in Design and Application of the Lysholm-Smith Torque Converter" (*Proc. Inst. Mech. Eng.*, May 3), Messrs. Haworth and Lysholm discuss the theory of blade friction and the results of experiments. The main points to be provided for in design are set forth and the results of experiments showing the effects of various blade angles and wheel diameters are given, together with the results of several applications, including a 1,000 h.p. variable blade converter.

Taken together, the three papers give a very good picture of the present position in this practically new method of fluid transmission.

The National Museum of Natural History, Paris

THE National Museum of Natural History, Paris, which was founded by Guy de la Brosse in May 1635 on the site of the Jardin des Plantes—"Le Jardin du Roy"—by an edict of Louis XIII, celebrated its tercentenary in Paris during the last week of June. The celebrations commenced on June 21 with a reception of the delegates by the director and the professors of the Museum, but the most impressive part of the various ceremonies was the *séance solennelle*, which was held in a special marquee erected in the Jardin des Plantes on the afternoon of June 25. This ceremony was attended by about 570 French and foreign delegates, representing 35 academies, 71 universities, 117 scientific institutions and 110 scientific societies, and was honoured by the presence of M. Albert Lebrun, the President of the Republic. The Minister of Education, M. Mario Roustan, presided, and the delegates presented their addresses at the commencement of the *séance*.

Speeches were made by M. Paul Lemoine, director of the Muséum National d'Histoire Naturelle; by the Governor-General, M. Olivier (president of the Society of Friends of the Museum); by M. Alfred Lacroix (member of the Institute and professor at the Natural History Museum), speaking in the name of the Academies; by M. M. Caullery (member of the Institute and professor at the Sorbonne), in the name of the French delegates; and by Sir Arthur Hill (director of the Royal Botanic Gardens, Kew),

in the name of the foreign delegates. The proceedings concluded with a speech by M. Mario Roustan, the Minister of Education.

Sir Arthur Hill, after referring to some of the distinguished botanists who had made the name of the Museum famous throughout the world, concluded a noteworthy speech, which brought the whole company to their feet, with the following words:

"Tous ceux-ci—et beaucoup d'autres—ont fait rayonner leur lumière sur le monde entier, au travers de ce Temple Renommé, le Musée National d'Histoire Naturelle.

"M. le Président, permettez à un botaniste de vous rappeler la fameuse parole de votre grand philosophe Pascal: L'homme fut perdu et trouvé dans un Jardin. Dans le premier jardin, le Jardin d'Eden, l'homme ouvrit la porte de la Science en mangeant le fruit de l'arbre de la connaissance du Bien et du Mal. Pouvons nous exprimer l'espoir que, non-seulement en France, mais au travers du monde entier, malgré les temps si troublés que nous traversons, unis dans un même idéal de tolérance et d'harmonie, les chercheurs de la Vérité verront leurs efforts récompensés par la découverte de cet autre arbre—'L'Arbre de Vie', dont les feuilles nous assureront la Paix eternelle, parmi les Nations?

"M. le Président, je prie mes collègues Délégués de se joindre à moi, et, debouts, de rendre hommage à la mémoire de ceux qui ont fait le nom de ce Musée si grand, et d'offrir avec moi nos meilleurs vœux pour la continuité de la prosperité et la gloire du Musée National d'Histoire Naturelle."

In the evening there was an official banquet attended by some seven hundred guests, and the Earl of Crawford spoke on behalf of the British delegates.

Another event of the week was the opening of the Grande Galerie de Botanique du Jardin des Plantes, the erection of which was assisted by a grant from the Rockefeller Foundation. This magnificent new building consists chiefly of the herbarium, which is one of the largest in the world. The building is fire-proof and the herbarium cabinets are constructed of metal. There is very limited table space, and most of the research work is carried out in the adjoining private rooms and laboratories, several of which have been set aside for the use of visitors. There is, moreover, particularly good accommodation for workers on the lower cryptogams, some seven rooms being set aside for algology, and an equal or larger number for mycology. Including more or less loosely attached workers, there is a large staff, but the new herbarium laboratories are also used by university students in connexion with research for degree theses.

Visits were paid to the Château of Chantilly and various museums, as well as to the zoological parks at Clères and Vincennes and the experimental grounds and laboratories of M. Vilmorin. The celebrations in Paris were very pleasantly brought to a close by a garden party at the Élysée, when the President of the Republic and Mme. Lebrun received the delegates.

At the end of the festivities an excursion was made to Mont Saint-Michel, Saint-Malo and Dinard, and at Dinard the new museum and aquarium, recently completed, was formally opened in the presence of a large number of the delegates.

Thanks to M. Lemoine, the director of the Museum, to Dr. Jeannel, who was acting as secretary, and his assistants, the arrangements for the celebrations were admirably carried out.

A very interesting exhibition of portraits of all the distinguished botanists, zoologists and others connected with the Museum, together with a fine collection of old prints and pictures and many other objects connected with the history of the Museum, had been arranged in the Exhibition Hall of the recently completed herbarium and botanical laboratories referred to above.

Academies, universities and scientific institutions from all over the world sent delegates to the celebrations. The following institutions, among others, of Great Britain, were represented: Royal Society (Earl of Crawford and Balcarres and Dr. C. Tate Regan); British Museum, Natural History (Earl of Crawford and Balcarres, Dr. C. Tate Regan and Mr. J. Ramsbottom); Royal Botanic Gardens, Kew (Sir Arthur Hill and Mr. A. D. Cotton); British Association (Mr. J. Ramsbottom); and the Linnean Society of London (Mr. J. Ramsbottom and Prof. G. D. Hale Carpenter).

Biological Distribution of Molybdenum

PROF. H. TER MEULEN, of Delft, continues his studies on the distribution of molybdenum in the organic world, with the help of Miss H. J. Ravenswaay (*K. Akad. Wet. Amsterdam, Proc.*, **38**, i; 1935; see also NATURE, **130**, 966; 1932). Finding in various samples of Dutch East Indian tobacco no less than 0·5–0·7 mgm. of molybdenum per kgm., he went on to determine the molybdenum content of the soil in a number of tobacco plantations. In some the amount was small, 0·01–0·07 mgm. per kgm.; in others it was ten times as much, 0·12–0·3 mgm.; and the latter were always the best plantations, growing the best tobacco.

Next, Prof. Ter Meulen extended some former studies of the seasonal variation of molybdenum in leaves; he finds in about a dozen different trees that the amount per kilogram, or per 1,000 leaves, either remains constant or sometimes increases considerably, from the young leaves of spring until the autumn leaves are about to fall. In other words, the molybdenum does not migrate from the old leaves to the other tissues of the plants, but merely returns with the fallen leaves to the soil. The horse-chestnut is an exception; here the amount of molybdenum in the leaves decreases in September and still more in October. But the horse-chestnuts themselves contain this element in considerable amount, and have, in all probability, withdrawn it from the leaves.

A third interesting point is a comparison of the molybdenum content in the brown and green varieties of *Prunus*, hazel and beech. Leaves were plucked on the same day, and the molybdenum estimated in mgm. per kgm. of moisture-free material. The curious and striking result was that in all three species the brown-leaved varieties were found to contain about twice as much molybdenum in their foliage as the green ones.

Still more recently, Prof. Ter Meulen has studied the molybdenum content of human teeth, sound and carious, and finds the sound teeth to be very much richer in molybdenum than the unsound. In all these cases it seems natural to suppose that the molybdenum is playing its part as a catalyst, and as such it would seem to be of widespread use and importance.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor announces that he has received a letter from Sir John D. Siddeley offering to the University the sum of £10,000, spread over a period of seven years, to help the development of aeronautical research and to assist the work of Prof. Melvill Jones and his associates in the Sub-Department of Aeronautics in the University. No specific conditions are attached to the offer, but Sir John Siddeley suggests that it may be found best to allow a considerable proportion to accumulate to form a capital endowment and to use the remainder for immediate purposes.

The Harkness Scholarship for 1935 has been awarded to Miss D. H. Rayner, of Girton College.

The Frank Smart Prizes are awarded to M. F. Mare of Newnham College (Botany) and D. W. Ewer, of Trinity College, and R. S. Sturdy, of Trinity College (Zoology and Comparative Anatomy).

LONDON.—University Postgraduate Travelling Studentships of the value of £275 for one year have been awarded to R. G. R. Bacon (Imperial College—Royal College of Science) and to A. E. J. Went (Imperial College—Royal College of Science). Mr. Bacon proposes to carry out chemical research in the University of Zurich, and Mr. Went will study the ecology of the mackerel in Norway.

The University Studentship in Physiology of the value of £100 has been awarded to R. A. Gregory (University College), who will carry on physiological research at University College.

OXFORD.—Lord Nuffield has given £16,000 for the purposes of the new institute for medical research. This is additional to the Radcliffe Observatory buildings and their surrounding land, which he bought when it was proposed to remove the observatory to South Africa. The institute is now to be called the Nuffield Institute for Medical Research.

In 1936 the Halley Lecture is to be delivered by Prof. P. M. S. Blackett and the Herbert Spencer Lecture by Emeritus Prof. J. A. Smith.

The Osler Memorial Medal for 1935, for the most valuable contribution to the science, art or literature of medicine made by an Oxford medical graduate, has been awarded to Dr. A. F. Hurst of Magdalen College.

SHEFFIELD.—The following appointments have recently been made: Dr. Francis Davies, reader in anatomy in King's College, University of London, to be professor of anatomy, in succession to Prof. C. J. Patten, who is retiring; Mr. R. T. Percival, to be lecturer in metallurgy (founding); Mr. John S. Bennett, to be assistant lecturer in metallurgy (founding).

THE following studentships and scholarships for 1935 have been awarded by the Royal Commission for the Exhibition of 1851, the name of the recommending university or college being given in brackets: *Senior Studentships*. Dr. Dorothy Hill (Cambridge), for research in geology at the University of Cambridge; S. F. Boys (Imperial College of Science and Technology, London), for research in physical chemistry at the University of Cambridge; Dr. H. Dickson (Imperial College of Science and Technology, London), for research in botany at the Imperial College; Dr. J. Walker (St. Andrews), for research in organic chemistry at the University of Oxford; Dr. W. C. Price (University College, Swansea), for research in physics at the University of Cambridge. *Overseas Scholarships*. R. C. Rose (Alberta), for research in physical chemistry at University College, London; Dr. A. B. Van Cleave (McGill), for research in physical chemistry at the University of Cambridge; J. S. Marshall (Queen's University, Kingston), for research in physics at the University of Cambridge; A. M. Crooker (Toronto), for research in physics at the University of Cambridge or the Imperial College of Science and Technology, London; J. R. Price (Adelaide), for research in organic chemistry at the University of Oxford; J. C. Bower (Melbourne), for research in physics at the University of Cambridge; J. W. Mitchell (New Zealand), for research in physical chemistry at the University of Oxford or King's College, London; Dr. H. A. Shapiro (Cape Town), for research in physiology at the University of Edinburgh. A number of senior studentships and overseas scholarships have been renewed for further periods.

Science News a Century Ago

European Aeronautical Society

UNDER the above heading, in *The Times* for July 14, 1835, was the following advertisement: "First Aerial Ship, the Eagle, 160 feet long, 50 feet high, 40 feet wide, manned by a crew of 17; constructed for establishing direct communication between the several capitals of Europe. The first experiment of this new system of aerial navigation will be made from London to Paris, and back again. May be viewed from 6 in the morning till dusk, in the dock-yard of the Society, at the entrance of Kensington, Victoria-road, facing Kensington Gardens, near the first turnpike from Hyde-park-corner. Admittance every day of the week 1s.; children half price."

A sketch and description of the airship appeared in the *Mechanics' Magazine* of July 18, 1835. The balloon or gas holder, it was said, was composed of 2,400 yards of cotton lawn, thoroughly varnished, and contained 7,000 cub. ft. of gas. The car was 75 ft. long and from it were worked the wings with which the machine was to be propelled.

The Scientific Association of Germany

IN its "Weekly Gossip on Literature and Art", the *Athenaeum* of July 18, 1835, said: "The Annual Meeting of the Scientific Association of Germany is to be held this year at Bonn on the Rhine, from the 17th to the 27th of Sept. At the meeting last year at Stuttgart, Dr. Christian Frederick Harless, Privy Councillor of Prussia and Professor of Medicine in the University of Bonn, and Dr. Jacob Noeggerath, one of the Directors in Chief of the Council of Mines for the Rhenish Provinces of Prussia, were respectively chosen President and Secretary of the ensuing meeting.

"The Geological Society of France meets in the beginning of September at Mezières and after examining the country there and around Namur, Liège and Aix-la-Chapelle joins the German Association at Bonn.

"There will be sufficient time to go to Bonn after the meeting of the British Association in Dublin, and we hope that our country will be worthily represented. . . . We know that, in the true spirit of German hospitality the Committee are anxious to provide

comfortable quarters for all strangers; but the town is small, and therefore they should get as early advise as possible. Letters should be addressed to Prof. Noeggerath."

The German Association was formed some years before the British Association, and Brewster, writing to Phillips on February 22, 1831, said: "It is proposed to establish a British Association of men of science similar to that which has existed for eight years in Germany, and which is now patronized by the most powerful sovereigns of that part of Europe."

Darwin in Peru

ON July 19, 1835, Darwin records that the *Beagle* anchored in the Bay of Callao, the seaport of Lima, the capital of Peru. Callao he found 'a filthy, ill-built, small seaport', while, owing to the troubled state of affairs, he was able to see little of the country. "I cannot say," he wrote, "I liked the very little I saw of Peru; in summer, however, it is said that the climate is much pleasanter. In all seasons, both inhabitants and foreigners suffer from severe attacks of ague. This disease is common on the whole coast of Peru, but is unknown in the interior. The attacks of illness which arise from miasma never fail to appear most mysterious. So difficult is it to judge from the aspect of a country, whether or not it is healthy, that if a person had been told to choose within the tropics a situation appearing favourable for health, very probably he would have named this coast. The plain round the outskirts of Callao is sparingly covered with a coarse grass, and in some parts there are a few stagnant, though very small, pools of water. The miasma, in all probability, arises from these: for the town of Arica was similarly circumstanced, and its healthiness was much improved by the drainage of some little pools. . . . In all unhealthy countries the greatest risk is run by sleeping on shore. Is this owing to the state of the body during sleep, or to a greater abundance of miasma at such times?"

Faraday on Tour in Switzerland

THE year 1835 was not one of Faraday's periods of great activity. It was in fact a time of rest and recuperation between the electrochemical researches, which were completed, and those on electrostatics, which he began to think of in November 1835. There is no entry of any kind in his Diary after April 27 until August, and in the month of July he was on a holiday tour in Switzerland with his wife and brother-in-law, George Barnard. The need for relaxation after a long period of hard work had evidently been felt, for in a letter he wrote to Magrath from Switzerland on July 19, he speaks of "occupation, fatigue and rheumatism". In the same letter he says: "We had a rough passage to Dieppe from Brighton, so rough that we found the French people wondering that we had ventured, but were so unhappy in our sickness as to be quite unconscious of everything else".

The party travelled by Rouen and Paris to Geneva, where Faraday met Prof. De la Rive again, and then to Chamonix and on for a tour of the mountain scenery. "We are almost surfeited with magnificent scenery", he wrote to Magrath; and again: "No artist should try to paint Mont Blanc; it is utterly out of his reach. He cannot convey an idea of it". They were back in England in August, for on August 6 the Diary entries begin again.

Societies and Academies

DUBLIN

Royal Irish Academy, June 25. H. L. MOVIUS, JR.: An excavation in the diatomaceous deposit of the Lower Bann Valley. The site, which was excavated in June 1934 by the Harvard Archæological Expedition to Ireland, lay at the base of an extensive deposit of diatomite where some thirty hearths were discovered. Implements of flint in addition to three polished stone axes were found. Typical of the industry are pointed flakes with a superficial tanging of the bulbar end. The site never served as a place of permanent habitation, since the hearths show evidence of seasonal floodings by the river. A nearly complete pot from quite near the site has proved to belong to the Windmill Hill family of Neolithic ware, according to Prof. V. G. Childe. The archæological evidence points to about the beginning of the second millennium B.C. as a rough date for the culture. Such a view is substantiated by Prof. K. Jessen's palæobotanical studies at the site, and on the basis of his work Late Atlantic to Early Sub-Boreal time is probable. As a whole, the industry seems to be an indigenous North Irish development derived from earlier coastal elements which had come in contact with a fully developed neolithic civilisation.

PARIS

Academy of Sciences, May 27 (*C.R.*, 200, 1805–1892). The president announced the death of Hugo de Vries, *Correspondant* of the Academy. ARMAND DE GRAMONT: An optical inverter. CHARLES CAMICHEL, JEAN PARMENTIER and LOUIS ESCANDE: Contribution to the study of liquid veins: multiple solutions: non-commutative operations. Experiments carried out on reduced models and on the Vives-Eaux barrage on the Seine. RENÉ MAIRE and LOUIS EMBERGER: The vegetation of the western Anti-Atlas. MARC KRASNER: The theory of the ramification of ideals. EMILE VAULOT: The application of the calculus of probabilities to the theory of telephone traffic. P. J. MYRBERG: The determination of the type of a simply connex Riemann surface. PIERRE BOOS: The general integral of certain differential equations considered as a function of the constants of integration. CARLO MIRANDA: A new criterion of normality for families of holomorph functions. NIKOLA OBRECHKOFF: The summation of the ultra-spherical series by the method of arithmetical means. GEORGES VALIRON: A generalisation of Schottky's theorem. EUGÈNE BLANC: Monotone multiform correspondences. GÉRARD PETIAU: A form of the equation of the photon. JULIEN KRAVTCHENKO: The validity of solutions of the problem of [ships'] wakes. F. CHARRON: Various utilisations of the bifilar suspension. L. DUNOYER: The principal cause of the inferiority of spirit-levels compared with liquid baths. JEAN P. E. DUCLAUX: The influence of light on the anodic polarisation of tungsten. ROBERT GUILLIEN: The electrical double refraction of liquid oxygen and nitrogen. MME. IRÈNE CURIE, HANS VON HALBAN, JR. and PIERRE PREISWERK: The artificial creation of the elements of an unknown radioactive family, during the irradiation of thorium by neutrons. MLLE. H. ZAVIZZIANO: The co-precipitation of protactinium with titanium. Titanium dioxide, formed by the hydrolysis of titanium

sulphate solutions, carries with it the whole of the protactinium in solution, and is better adapted for this purpose than the substances hitherto employed. VICTOR LOMBARD and CHARLES EICHNER: The large and sudden variation in the permeability of palladium to hydrogen at a temperature just below 200° C. Palladium foil loses 99·95 per cent of its diffusive power to hydrogen by cooling from 225° C. to 125° C. The critical temperature, which varies slightly with the purity of the metal, is between 180° C. and 190° C. The author regards this not as being due to a change of state of the metal but as a change of behaviour of hydrogen towards the palladium. MLLE. NIUTA KLEIN: Study of the inequalities of the index of refraction of a glass. ELIE RAYMOND: A method for the quantitative separation of nickel and cobalt. ANDRÉ DE PASSILLÉ: The thermochemistry of the ammonium arsenates. PIERRE BRAUMAN: The isoamyloxyvanadylsalicylates. ALFRED MAILLARD: The hydrogenation of anthracene. The addition of hydrogen to anthracene is a reaction similar to the hydrogenation of naphthalene; the addition takes place in stages and the reactions are reversible. E. VELLINGER and G. RADULESCO: The use of cracked spirit in internal combustion motors. The unsaturated hydrocarbons are valuable in preventing knocking, but the tendency to gum formation is objectionable. The latter can be removed by adding stabilisers such as polyphenols: that this addition prevents gum formation has been confirmed by experiment. GEORGES DUPONT and RAYMOND DULOU: The presence of active secondary butyl alcohol in certain fusel oils. A sample of propyl alcohol, sold as pure, was found to contain 17 per cent of active secondary butyl alcohol. JEAN WYART: The crystalline structure of paratoluidine. STOYAN PAVLOVITCH: The petrographical study of the peridotites of the Zlatibor massif (Western Serbia). GILBERT MATHIEU: The age of the primary series without fossils of Vendée. JEAN MICHEL: Observations on the projections in the chalk between Tréport and Ault. ADOLPHE LEPAPE and GEORGES COLANGE: The composition of the air of the stratosphere. The air of the stratosphere has the same composition as at the ground-level and it would appear that the atmosphere has sensibly the same composition throughout. L. DONCIEUX and J. CUVILLIER: The Foraminifera of the lower Lutetian in the south of the Arabian desert. GEORGES ADAM NADSON: Hereditary variations produced experimentally in yeasts. Starting with a single yeast cell, under the influence of the X-rays various new stable strains of yeasts have been obtained. These yeasts are so distinct that, if found in Nature, they would be classified not only as different species, but even as distinct genera. The distinctive characters have been maintained after several years of culture. EMILE MIÈGE: The indigenous cultivation of the potato in the mountainous regions of Morocco. The potato has been cultivated for a long period in the mountain regions of Morocco. In spite of the primitive methods, two crops a year with high yields without degeneration have been obtained. These results show the favourable effect of cultivation at a high altitude. LÉON BERTIN: The *Oxystomus* of Rafinesque is a distinct form among the leptocephalian larvæ. ALPHONSE LABBÉ: The silicogen function in the Silicoderms. JAMES BASSET, STEFAN NICOLAU and MICHEL A. MACHEBŒUF: The action of ultra-pressure on the pathogenic action of some viruses. JACQUES PARROD: The formation of hydrocyanic acid and urea by the oxidation of cellulose, in ammoniacal solution, at laboratory temperature. MLLE. HÉLÈNE WINOGRADSKY: The nitrifying micro-flora of activated sludge of Paris. E. GRASSET: Preliminary results on the treatment of human tuberculosis by means of living formolised lysates of B.C.G. and tuberculous bacillus.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 31, No. 4, April 6). L. GODEAUX: (1) Researches on the cyclic involutions belonging to an algebraic surface. (2) The order of the rational correspondences between two surfaces each of genus one. TH. DE DONDER: Application of quantum mechanics to generalised statistical mechanics. L. HENRIOT: Electromagnetic moments. A discussion of the vectors torque and momentor in Lorentz's electromagnetic theory and a comparison with the results of Maxwell's theory. G. BOULIGAND: On certain linear classes of functions. M. WINANTS: Solution of the problem (a_6, IV, 1). J. GÉHÉNIAU: Generalisation of the formulæ of excess of Weierstrass deduced from the theorem of independence of Hilbert – De Donder. YVONNE DUPONT: De Donder's thermodynamic synthesis applied to the Nernst and Ettingshausen transverse effects (2). GEORGETTE SCHOULS: Application of statistical mechanics to the thermodynamics of a gas. Theoretical considerations leading to a calculation of the molar entropies of chlorine, bromine and iodine, allowing for the energy of vibration. J. M. DELFOSSE and R. GOOVAERTS: Raman spectrum of silicobromoform. Comparison of the Raman effect in silicobromoform with that in chloroform, bromoform and silicochloroform. H. WUYTS and R. VERSTRAETEN: Optical analysis and rotatory power of the glycothiodiazolines. M. FLORKIN: Influence of the cryoscopic depression of the exterior medium on that of the blood and urine of *Anodonta*. B. ROSEN and M. DÉSIRANT: Researches on the molecular spectrum of selenium vapour. H. SAUVENIER: Some remarks on the subject of the interpretation of the shift towards the red of the spectral lines of nebulæ. M. NICOLET: Identification of the lines of neon in the spectrum of *B* stars. M. LEGRAYE: Note on a particular fuel in the Famenian of the Couthuin region. J. MELON: Analysis and optical properties of thoreaulite.

GENEVA

Society of Physics and Natural History, May 16. M. GYSIN: Copper minerals of Kinsenda (Belgian Congo) (2). Presence of two varieties of chalcosine. Studying the minerals of Kinsenda (Belgian Congo), the author has observed two varieties of chalcosine, a blue chalcosine, isotropic, formed by hypogene replacement of primary bornite, and a white chalcosine, granular, anisotropic, formed by supergene replacement of blue chalcosine and of chalcopyrite. E. BRINER and M. CARCELLER: Catalytic action of oxidation exercised by ozone in the oxidation of hydrocarbons. E. CHERBULIEZ and R. WEIBEL: Action of sulphur on water below 100° C. and the geological significance of this reaction. P. WENGER, C. CIMMERMANN and C. RZYMOWSKA: The gravimetric micro-estimation of potassium in the presence of sodium by means of chlorplatinic acid. The authors specify the conditions of F. Emich's micromethod for the determination of potassium in the presence of ten times the quantity of sodium, and have

established a micromethod based on the work of Smith and Gring. C. CIMMERMANN and P. WENGER: The micro-estimation of zinc by means of anthranilic acid. The authors have worked out a rapid and exact micromethod based on the use of this reagent.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 1, 1935). I. VINOGRADW: On approximation by means of rational fractions having powers of total numbers for denominators. V. IGNATOVSKIJ: The Laplacean transformation. L. RADZISHEVSKIJ: Contribution to a general theory of linear functional equations. V. KUPRADZE: A generalised 'principle of radiation' in the theory of elasticity. L. LEIBENSON: (1) The theory of the turbulent boundary layer. (2) The energy form of the integral condition in the theory of the boundary layer. A. MITKEVITCH: The influence of mechanical vibration on the subsequent manifestations of magnetic viscosity. V. IPATJEV and W. TRONEV: The separation of metals of the platinum group by hydrogen under pressure. M. KABATSHNIK and M. KATZNELSON: Amination of alkaloids with sodium and potassium amides. A. KLEBANSKIJ and K. CHEVYCHALOVA: Synthesis of β-chlorpropionic acid by condensation of phosgene with ethylene. P. BORODIN and M. GADD: An investigation of the radioactivity of the springs of the Ilmen district and of Lake Turgoyak (South Urals). M. CLAIRE: Some notes on the hydrogeology of the springs of the Ilmen district and of Lake Turgoyak (South Urals). V. LEVSHIN and M. ALENCEV: Researches on the phosphorescence of calcites. J. SALKIND, S. SONIS and N. BLOCHIN: Studies in the synthesis of vitamin A. (1) The action of magnesium-bromvinyl-acetylene on the β-ionone. (2) Biological properties of the product of synthesis. Z. KATZNELSON: The sources of development of the latero-ventral part of the body muscles and of the tail muscles in Amphibia. V. DONTCHENKO and N. MEDVEDEV: A case of dependence of success of interspecific hybridisation upon a single gene. DONTCHO KOSTOFF: Changes in karyotypes induced by centrifugation. V. CIVINSKIJ: The effect of fruiting upon transpiration. N. KALABUKHOV: The physiological peculiarities of the mountain and the plains sub-species of the forest mice (*Apodemus sylvaticus ciscaucasicus* Ogn. and *A. sylvaticus mosquensis* Ogn.).

MELBOURNE

Royal Society of Victoria, April 11. AUSTIN B. EDWARDS: Three olivine basalt-trachyte associations and some theories of petrogenesis. Investigation of the olivine basalt-trachyte associations in three Tertiary igneous provinces, in Victoria, at Otago in New Zealand, and at Kerguelen Island, supports the theory advanced by W. Q. Kennedy that alkaline lavas are the normal product of differentiation of an olivine-basalt magma, so long as there is no undue amount of contamination by contemporary syntexis. Desilication of basaltic magma by its assimilation of calcareous sediments has not occurred in either of the three provinces. In the absence of an immediately previous orogeny, such alkaline rocks will develop in a continental region as readily as in an oceanic region; but an orogeny appears to provide conditions favourable to large-scale assimilation of siliceous and argillaceous sediments, with an accompanying production of andesitic types.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, July 14

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. Burton: General Tour of the Museum.*

INTERNATIONAL CONGRESS FOR SCIENTIFIC MANAGEMENT, July 15–19.—Sixth Congress to be held in the Central Hall, Westminster, S.W.1.

July 15 at 12. Opening of the Congress by H.R.H. the Prince of Wales.

Official Publications Received

Great Britain and Ireland

Annual Report of the Council to the Members of the City and Guilds of London Institute, to be presented at the Yearly Meeting in May 1935. Pp. liii+112. (London: Gresham College.)

The National Central Library 19th Annual Report of the Executive Committee, 1934–35. Pp. 57. (London: National Central Library.)

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 463: Biological and Ecological Factors in the Control of the Celery Leaf Tier in Florida. By E. D. Ball, J. A. Reeves, B. L. Boyden and W. E. Stone. Pp. 56. (Washington, D.C.: Government Printing Office.) 10 cents.

Agricultural Experiment Station of the Rhode Island State College. Bulletin 247: Blackhead (Entero-Hepatitis) Investigations. By John P. Delaplane and Homer O. Stuart. Pp. 16. (Kingston, R.I.: Rhode Island State College.)

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Fiskeri, Bind 10, Nr. 1: Cod Marking Experiments in the Waters of Greenland, 1924–1933. By Paul M. Hansen, Ad. S. Jensen and A. Vedel Tåning. Pp. 119. (København: C. A. Reitzels Forlag.)

Zoologica. Vol. 19, No. 3: A Second List of Antillean Reptiles and Amphibians. By Thomas Barbour. Pp. 77–141. (New York: New York Zoological Society.)

Ceylon Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for the Year 1934. By A. H. Malpas. Pp. G7. (Colombo: Government Record Office.) 10 cents.

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovo (Stockholm) im Jahre 1931. Pp. 95. (Stockholm.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 87: 1. On the Rotation of the Plane of Polarisation of Long Radio Waves, by Dr. A. L. Green and Dr. Geoffrey Builder; 2. A Field-Intensity Set, by Dr. A. L. Green and H. B. Wood; 3. Measurements of Attenuation, Fading and Interference in South-Eastern Australia, at 200 Kilocycles per Second, by G. H. Munro and Dr. A. L. Green; 4. A Frequency Recorder, by Dr. D. F. Martyn and H. B. Wood. (Radio Research Board, Report No. 6.) Pp. 58. Bulletin No. 88: 1. The Propagation of Medium Radio Waves in the Ionosphere, by Dr. D. F. Martyn; 2. The Characteristics of Downcoming Radio Waves, by Dr. D. F. Martyn and Dr. A. L. Green; 3. The Influence of Electric Waves on the Ionosphere, by Dr. V. A. Bailey and Dr. D. F. Martyn; 4. Long Distance Observations of Radio Waves of Medium Frequencies, by Dr. D. F. Martyn, R. O. Cherry and Dr. A. L. Green. (Radio Research Board, Report No. 7.) Pp. 63. Bulletin No. 89: 1. Simultaneous Observations of Atmospherics with Cathode Ray Direction-Finders at Toowoomba and Canberra, by G. H. Munro, Dr. H. C. Webster and A. J. Higgs; 2. Atmospheric Interference with Reception, by W. J. Wark. (Radio Research Board, Report No. 8.) Pp. 61. Pamphlet No. 54: Thrips Investigation; Some Common Thysanoptera in Australia. By H. Vevers Steele. Pp. 59. (Melbourne: Government Printer.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. South American Land and Freshwater Mollusks, 9: Colombian Species. By Henry A. Pilsbry. Pp. 83–88. (Philadelphia: Academy of Natural Sciences.)

Bulletin of the American Museum of Natural History. Vol. 68, Article 5: The Taxonomy of the Genera of Neotropical Hystricoid Rodents. By G. H. H. Tate. Pp. 295–447. (New York: American Museum of Natural History.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 27: Combing of Good Quality Indian Cottons. By R. P. Richardson and Dr. Nazir Ahmad. Pp. 31. (Bombay: Indian Central Cotton Committee.)

Nigeria. Sessional Paper No. 17 of 1935. The Nigerian Goldfield. By Dr. W. Russ. Pp. 11. (Lagos: Government Printer.)

Catalogues

A Catalogue of Scientific Periodicals and Publications of Learned Societies and Public Institutions. (No. 506.) Pp. 68. (London: Bernard Quaritch, Ltd.)

Sands, Clays and Minerals. Vol. 2, No. 3, June. Pp. 160. (Chatteris: Algernon Lewin Curtis.)

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WHITEHALL 8831

NATURE

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

No. 3429 SATURDAY, JULY 20, 1935 Vol. 136

Chemistry and Citizenship

CHEMISTS, like members of other professional classes, remind themselves from time to time that their vision should extend beyond their professional interests and services into the wider field of the community at large, so that they may bring their specialised knowledge to bear on the problems which their own actions have raised. Not that scientific people are insensible to their duties as intelligent citizens—far from it; but they tend rather to measure their own success or failure in adding to the general store of knowledge, or power, or well-being through spectacles which leave out of focus important considerations none the less real because they are awkward. The physician strives to save life and prolong it; if he succeeds, we applaud him as indeed we should, for has he not contributed to human happiness? But is it, or is it not, the business of the medical man also to see that the effect of an increase in the expectation of life on, say, the vigour of the governing class, or the chance of employment, or the support of the aged, or the use of leisure, is properly examined? And if he takes up the study himself, since it is clearly impossible for him to refuse medical aid to the sufferer, is he in any better position than his patient to help in the development of a scheme of education and social order suited to the new conditions which he has created?

To judge by one or two lectures which have recently been delivered, chemists are giving attention to the social effects of their own chemistry and industry. Having invented means of producing goods with less labour (although part of the displaced labour has been absorbed in new directions of their own devising), some at least are wondering whether it is not after all their duty to do something rather more definite and vigorous about the social consequences. They are wondering whether the same amount of scientific study given to such disturbances of social equilibrium as is given to the material results of scientific inquiry might not have beneficial results in indicating the best directions of scientific development, as well as in alleviating the troubles which for all our science we have been unable to avoid. Thus Mr. W. M. Ames, in a lecture on "The Chemist and the Community" reported a little time ago in *Chemistry and Industry*, advocates the scientifically planned State as the logical sequel of the application of science to industry. He wants to establish it without interfering with the freedom of leisure, and without forgetting (as he claims rationalised industry has almost forgotten) that human nature has its failings. He proposes, for one thing, a reduction of working hours, and deplores that such a proposition has been allowed to become a political question instead of being treated as a problem of industrial management. He finds it hard to say whether or not science and human nature would come to blows during the evolution of the scientific State—for various reasons the information to be gleaned from the Russian experiment is not very helpful to others—but he declares that two million unemployed is a price we cannot afford to pay for the pleasure of muddling along.

Whatever we may think of the means available for its solution, there can be no argument about the problem. Each and every new scientific or industrial advance, whether it brings a new source of employment, a desired or enforced leisure, a longer lease of life, or a quicker way of killing people, sets up ripples and echoes which it is our

business to trace before they get beyond control and threaten to involve our social fabric in revolution instead of ordered evolution. We cannot stop learning, even to please superior people who have persuaded themselves that too much natural knowledge is antagonistic to their rules for human behaviour. They naturally prefer the latter (which admit of manipulation and alteration) to the former (which does not), and hence they complain that all this knowledge is doing us little good.

Our thesis is that more information about the social relationships of science would help to restore our balance and would lead to better government as well as better science. What, for example, is the proper attitude for scientific workers to take in relation to war? The chemist's part in modern warfare is popularly realised if not understood; and it makes good journalistic copy when normal manufacturing processes become the production of secret explosives, and poison gas exudes from every peaceful cauldron. Preparation for war does, however, call for the services of chemists, and Mr. R. Brightman, who a little time ago discussed at Manchester the place of professional organisations in society, asks scientific workers to formulate a definite ethical code towards preparation for war. In a recent issue of *The Chemical Practitioner* he points out that so long as there is real risk of war, the fullest resources of science should be used to make warfare efficient, economical and unlikely, but that "while it might be accepted as part of the scientists' general code that research work in connexion with general war needs was always legitimate, it might equally be held that research on agencies prohibited by international agreement or participation in large scale production of armaments in peace time was illegitimate".

The trouble is that any such scheme, to be effective, would have to be universal; unilateral action might well be a disservice to the cause of peace. What is the chemist to reply if he is asked to help in arranging protection for the civil population against aerial gas attacks? Is he to point to the Geneva Protocol and hope for the best, or is he to allow his natural humanity to overcome his faith in human nature? This very subject of the education of the public in means for dealing with gas attacks was quite lately discussed before the British Science Guild by Mr. J. Davidson Pratt, the general manager of the Association of British Chemical Manufacturers. The question of the scientific worker's duty in relation to the preservation of peace and to the provision of military necessities is obviously presenting doubts and difficulties to conscientious minds, which is all the more reason why the whole matter should receive earnest attention by professional organisations of scientific workers.

Mr. Ames truly says that if at any time the nation is drawn into a war the chemist's duty is the same as that of any other citizen; but that duty should not prevent him using his special powers and opportunities to strive with all his might against the warlike frame of mind and to harness the spirit of adventure to combat evils and distresses which familiarity almost persuades us to ignore. He finds the nobler adventure in a determined effort to provide work for everybody, and in doing so much he is doing more to undermine the causes of unrest.

Mr. Brightman thinks that scientific workers have come more and more to realise that, even in its narrowest sense, scientific or professional work is not something entirely apart from the life of society; that it cannot be truly isolated, and that it has to be integrated into the general life of the community. One of the ways in which this could be done more effectively would—as we have suggested before—be through the medium of the Press and of broadcasting. The social reformer gets ample opportunity for advocating his ideas for promoting the public advantage; his schemes for abolishing this and nationalising that. But the chemist (if we may take him as an example) speaks mostly through his own journals to his own people. It is necessary to impress on the public mind a picture of science in the making and science in application, to illustrate the aims, ideals and methods so familiar to the scientific worker but so little understood by the commercial public, to discuss the ways in which this new knowledge is being used, or might be used for the public good, and to examine with equal candour the possible repercussions which we would rather avoid. It is of no use trying to plan an unwilling State; nor will the State be willing until it understands a great deal more of the minds and the methods to be utilised. But it is learning by precept and by trial-and-error where organisation may usefully operate to the public profit, and where it still seems best not to limit individual freedom. The more it knows—not about chemistry, for example, but about the part which chemists play in national life—the

more will it be ready to listen to their advice; and the more chemists study the community, the more fit will they be to tender it.

Research workers cannot be a class apart in this modern world; they must mount the platform and advertise their wares. Individuals who have the ability as well as the knowledge can seek to use the popular Press as their tribune—and the Press will be willing enough if they attract readers; a science news service such as has been operating in the United States of America for some years past might be set up by a combination of professional organisations in Great Britain; and the universities might organise a comprehensive service in co-operation with the broadcasting authorities.

In any event, we shall not make the mistake of crying science as a panacea for all ills, for there are few of us who do not set great store by the preservation of moral and spiritual values; but we feel that in our scientific work we are carrying a responsibility which we cannot adequately discharge without public assistance in the widest and least mercenary sense of the term.

The Foundations of Modern Science

A History of Science, Technology and Philosophy in the 16th and 17th Centuries

By Prof. A. Wolf, with the co-operation of Prof. Dr. F. Dannemann and A. Armitage. (History of Science Library.) Pp. xxvii+693+68 plates. (London: George Allen and Unwin, Ltd., 1935.) 25*s*. net.

THE book before us deals not only with pure science, but also with technology and philosophy. It is thus able to place science in a frame of other knowledge, and show the relations and cross-connexions between them. This method is desirable, indeed necessary, if a true appreciation of the picture is to be obtained. The early development of modern science was inevitably influenced by the philosophic environment in which it grew, and gained much by the gradual improvements in scientific implements, and by the problems thrust upon science by medicine and technology.

It will be seen how wide is the field which Prof. Wolf sets out to cover. It comprises several subjects not usually included in histories of, or treatises on, science—an extension which certainly adds to the interest of the whole. But this volume is but part of the scheme. In the preface we read:

"The present book is complete in itself. It is, however, intended to be only an instalment of a complete history of science. The author proposes to deal with the eighteenth and nineteenth centuries next, and then with ancient and mediæval times. But each volume will be as nearly as possible self-contained."

This extract serves to place Prof. Wolf's work between the encyclopædic "History of Science" of Dr. G. Sarton and the various specialised histories of particular branches of science on one hand, and single volume histories of science on the other.

The two centuries under review open with scholasticism still a power, though a waning power, in the intellectual world. Scholasticism reached its zenith in the thirteenth century, when the acute mind of St. Thomas Aquinas put together a logical, and within its limits, a complete scheme of existing knowledge, based on the Christian faith as interpreted by the Roman Church, and Nature as described by Aristotle. Accepting these two authorities, the scholastic philosophy seemed to the late Middle Ages to follow by deduction both logically and inevitably. This is what Whitehead means when he describes modern science, which is primarily inductive and not deductive, as "a recoil from the inflexible rationality of mediæval thought". Wolf criticises this pronouncement, saying that "due regard for the stubborn facts of observation is an essential part of any thoroughgoing rationality". Here, I think, he somewhat misunderstands Whitehead's meaning. But he is right in pointing out the influence of the Pythagorean emphasis on number in forming the thought of Copernicus and Kepler, though he seems to miss the point that this "earlier Greek tradition" persisted through the Middle Ages, first as the leading philosophy, and then as a survival, underlying, as an alternative, the prevailing late medieval Aristotelianism.

Although Aquinas himself was ready to consider the possibility of a moving earth, the geocentric theory, in the minds of lesser men, had become part of scholasticism. Thus the Copernican revolution was not only a simplification, and therefore a mathematical improvement, on the cycles and epicycles of Hipparchus and Ptolemy, but also a threat to reduce the earth, the home of man,

from its central throne to the humbler rôle of one of the planets. Luther and his reformers opposed it from the beginning, and Catholic theologians only allowed it as a mathematical speculation. Hence, when Galileo confirmed it as physical reality by astronomical observations, and, greatly daring, set out for Rome to convert the Papal Court to Copernicanism, both scholastic philosophers and orthodox cardinals would have none of it.

Galileo's work in founding dynamics, if less spectacular than his discoveries in astronomy, was perhaps of even greater importance. Prof. Wolf gives a good account of this work taken in isolation. But here, as elsewhere in the book, there seems a certain want of appreciation of the connexions and cross-connexions which bind together the work of several men. As Mach pointed out, the fundamental dynamical investigations of Galileo, Huygens and Newton really mean the discovery of only one principle. It was an accident of history which caused force and momentum to seem simpler and more primary than Huygens' ideas, equivalent to our modern concepts of work and energy.

The chapter on scientific academies shows the great help given by them, through the association of men of science, to the early development of natural knowledge, and the account of scientific instruments makes clear the dependence of accurate measurement on the skill of the technician.

The story of the construction of the great Newtonian synthesis, in the more recent light which has been thrown on the points at issue, is well set forth in Chap. vii. The revolution in science begun by Galileo was thus, in all essentials, completed. Not until the present age was so complete a change in outlook produced in one lifetime and recognised as such by the instructed world. The full repercussion of Newton's work on philosophy was not felt until the eighteenth century, and is therefore outside the scope of the present volume, but the scientific effects were overwhelming and immediate.

The development of mathematics went hand in hand with the development of astronomy, and, if other branches of physics began each in isolation, they were preparing for mutual inter-action at a later date. Light was examined by Kepler, who gave a geometrical explanation of the telescope; Snell, who hit on the true law of refraction; Fermat with his principle of minimum time of passage which connected Snell's law with the velocities; Grimaldi, who first suggested seriously the wave theory of light; Huygens, with the principle that each small element of a wave front acts as the centre of an elementary wavelet; and Newton, who first gave the true theory of the colours of the spectrum.

Until the seventeenth century, little or no clear distinction was made between heat, fire and flame, and throughout that century there was controversy whether heat was essentially "fire atoms" or molecular motion—indeed Robert Boyle, who in general upheld the view that heat was "the super-induced commotion of small parts" of bodies, explained the gain in weight of a metal on calcination by the absorption "of atoms of fire". For a consensus of opinion about the nature of heat, men had to wait for Joule in the nineteenth century.

The vibrations of sounding strings were studied by Galileo, who realised that the period of vibration is the determining factor in the pitch of a musical note. The velocity of sound was measured by Gassendi and others, while Guericke, after inventing the air pump, showed that sound would not travel through an exhausted space.

The modern experimental science of magnetism and electricity was founded by Gilbert of Colchester. Descartes attempted to explain magnetism by an application of his general theory of vortices, but, except for various observations on the mariner's compass, not much more was done during the period.

Meteorology, like other sciences, depends on suitable instruments, and until the invention of the thermometer, barometer and rain gauge, nothing much could be done. But with them a number of continuous meteorological records were made in the seventeenth century. Among the navigators, William Dampier made observations on winds and ocean currents, while the physicists Halley and Hooke speculated as to causes.

At the beginning of the period, chemistry was subject to three main tendencies: (1) the alchemists' search for the philosophers' stone; (2) the use of chemical remedies in medicine, especially by Paracelsus; (3) the need of chemical knowledge in the mining industry. This last subject is of great interest; it is not often mentioned, and Prof. Wolf does right to bring it forward. As regards chemical theory, until Robert Boyle published the "Sceptical Chymist" in 1661, it was a mass of confused notions, in which explanations were sought in Aristotelian terms of occult qualities or 'substantial forms'. Boyle was followed by Lower and Mayow, who combined chemical with physiological researches, and did much to elucidate the process of respiration.

After chapters on geology and geography, we come to the biological sciences, which, subordinate to medicine at the beginning of the period, won an independent place in its course. A quite new

field of research was opened up by the invention of the microscope, while physiology was revolutionised by Harvey's discovery of the circulation of the blood. Thus Prof. Wolf passes to medicine, with an account of the most famous physicians of the time.

The chapters on technology show that, during the period under review, "science learned from existing technical methods rather than taught them". The converse effect only became generally important at a later date. But the accounts of agriculture, textiles, building problems, mining and mechanical engineering illustrate the gradual application of more systematic methods in industry. These accounts are accompanied by copies of many contemporary prints.

The chapter on psychology perhaps suffers somewhat by being placed before and not after that on philosophy. The chapter on the social sciences contains interesting reproductions of early Bills of Mortality and other examples of the introduction of statistical methods into the study of social phenomena, while it is shown that the problem in practical economics which occupied the statesmen of the time was based on the idea of increasing national wealth by a "favourable balance of trade", whereby not only necessary commodities but also an excess of precious metals might come from abroad.

The final chapter traces the formal separation of science from theology and then from philosophy, and their mutual reactions when each was pursued by methods of its own. In this chapter more might have been made of the fundamental change wrought by Galileo. His work replaced the homocentric philosophy of scholasticism, with space and time as unimportant categories, by a return to the concepts of Democritus, who visualised reality in terms of atoms and a void, and reduced the qualities of colour, sound, taste, hotness and coldness to mere sensations in the observer's mind. The rest of the chapter traces well the thought of such men as Bacon, Hobbes, Descartes, Spinoza, Locke and Leibnitz, and ends, as a book on seventeenth century science should, with Newton. Prof. Wolf is to be congratulated on a volume, which, if not perfect, is yet a notable achievement.

W. C. D. DAMPIER.

The Salamander

The Anatomy of the Salamander

By Dr. Eric T. B. Francis. With an Historical Introduction by Prof. F. J. Cole. Pp. xxxi + 381 + 26 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1934.) 25*s*. net.

SALAMANDER is a name not unknown to folklore, mythology or even slang. Henceforward it must be more than a nominal acquaintance of every zoologist, without distinction of creed or class, for Dr. Francis has given us a book with a much wider appeal than its title would suggest. In his preface the author says that : "Its intention is to provide a general account of the anatomy and morphology of a tailed Amphibian—the Salamander, which shall, within limits, be comparable with the work of Ecker and Gaupp on its ecaudate relative—the Frog". There can be no doubt of his successful achievement of this object, and the two works are not only comparable but also complementary ; the easiest way of discovering the latest morphological nomenclature and the most recent views on the homologies of anuran structures is to compare the relevant sections in the two books.

The system of the two is essentially similar. Each group of organs is considered separately, its components being described fully but concisely, and illustrated by numerous clear, diagrammatic figures ; following each chapter are the pertinent references. But although the system is similar, there is one very important difference in the descriptive methods. Dr. Francis is never didactic, and in any instance where there are differences of opinion an impartial summary of the conflicting points of view is given. Though the book is primarily intended for the amphibian morphologist, whether student or teacher, it is these critical summaries, and the references, which render the volume so useful to other vertebrate zoologists.

The bibliography contains no less than 840 titles (of which only four per cent have not been personally examined by the author) and, though this testifies to the enormous amount of work which has previously been done on the subject, Dr. Francis is no mere literary compiler. There are numerous original observations, and the author has personally investigated all the structures he describes. Modern technical methods have been utilised to check the findings of earlier workers, and special or new methods are described where they have been found particularly suitable.

No work of this magnitude can be perfect in

every way. The arrangement of nearly all the figures on a series of plates at the end of the volume does not make for ease of reference, especially as many of them are exceedingly intricate; to follow the text in one place, the figure in another and find the meaning of an abbreviation on the plate (there are more than nine pages of these abbreviations) is no light task.

Again, the taxonomic and zoogeographical chapters are disappointing, for nothing is said of the numerous described subspecies of the salamander and only three 'varieties' are recognised. What the author's concept of a 'variety' may be is not explained, but as the '*var. molleri*' is said to occur all over the Iberian Peninsula side by side with the '*Forma typica*' it is presumably not the same as a subspecies. No explanation of the use of the name *molleri* (the date of which is wrongly given as 1896 instead of 1889) in preference to the older *galliaca* is offered, and the map showing the species as occurring in the Balearic Islands, Sicily, Crete and Cyprus is very misleading. But, since these chapters are merely incidental to the main theme, and are, moreover, merely repetitions of mistakes by other workers, they do not seriously detract from the value of the book for its primary purpose. There are also some slips (such, for example, as in references 779–781, where the author's name should read "Werner" instead of "Weliky"), which will prove troublesome to the student, and though trivial in themselves are blemishes on an otherwise admirable piece of work.

Modern Views on Magnetism

Magnetism and Matter

By Dr. Edmund C. Stoner. Pp. xv+575. (London: Methuen and Co., Ltd., 1934.) 21*s*. net.

DR. STONER and all physicists interested in magnetism are to be congratulated on the appearance of this admirable monograph. In 1926, the author published a book on the same subject, "Magnetism and Atomic Structure". The present treatise, far from being merely a revised edition of its predecessor, is practically an entirely new work, in which full justice is done to the considerable progress resulting from experimental and theoretical research in the course of the last ten years (electronic spin, quantum mechanics, etc.).

After a historical introduction, which makes delightful reading, short accounts are given of the necessary theoretical tools of classical and quantum physics in Chapters ii and v respectively, Chapter iii giving a lucid exposition of experimental methods and Chapter iv describing earlier results and theories (Ewing, Curie, Langevin, Weiss). After three chapters on the Zeeman effect (in atomic spectral lines only), magnetic deviation of atomic rays and gyromagnetic effect, an extensive review is given of diamagnetism (Chapter ix, pp. 251–279), paramagnetism (Chapter x, pp. 280–349) and ferromagnetism (Chapter xi, pp. 350–437), the author's interest being everywhere harmoniously divided between the exposition of facts and of their theoretical interpretation. Then follows an account of Kapitza's measurements in very strong fields (Chapter xii), of molecular magnetism (Chapter xiii) and of the magnetic properties of metals and alloys (Chapter xiv). The work ends with useful appendixes and an extensive author- and subject-index.

With a vast subject such as magnetism, it is often a very difficult question to what extent experiments and theories claim a general scientific interest. The author's choice in this respect is very much to be admired indeed; his own important contributions to the theory, for example, have been presented in the same objective manner as those of others, and he has shown a very wise self-restraint in practically leaving out such subjects as magneto-optics and magneto-electricity. At the same time, the reader gets a vivid impression that magnetism is a very living branch of physics nowadays; many of the theories recorded still bear a strongly speculative character, but the way in which it is done adds highly to the charm of the book. Consequently objections which here and there can be raised may easily be due to personal taste.

The classical discussion of the energy of a magnetised body in Chapter ii is, in the reviewer's opinion, scarcely a satisfactory basis for the general laws which are derived from it. More attention might perhaps have been directed to the calculations of Penney and Schlapp, which give an important contribution towards the understanding of the wide applicability of Weiss's law in paramagnetics. As regards anisotropy of ferromagnetic single crystals, it is questionable if the current atomistic explanation of this phenomenon can withstand the touch of criticism. Remarks like these, however, if valid at all, do not affect the intrinsic merits of Dr. Stoner's excellent book.

H. A. K.

Veterinary Helminthology and Entomology: the Diseases of Domesticated Animals caused by Helminth and Arthropod Parasites. By Prof. H. O. Mönnig. Pp. xvi+402. (London: Baillière, Tindall and Cox, 1934.) 30*s*.

PROF. MÖNNIG, who is professor of parasitology in the Veterinary Faculty of the University of Pretoria, is well-qualified to write a work of this character. The aim of his book is to give an account of the helminth and arthropod parasites of domestic animals and, at the same time, to stress those practical aspects of the subject most useful to the veterinarian. The morphology of the parasites concerned is dealt with in a general way and sufficient account is given about their general characteristics to enable specific parasites to be identified. The parasitic diseases themselves and their treatment come in for rather fuller consideration. The chief parasites of the common domestic animals of the world, and also kindred creatures affecting fur-bearing mammals, are included. If important parasites have been omitted it is only because, the author states, discrimination on this subject is difficult on the basis of existing knowledge.

The book is divided into four parts or sections, of which Sections I and II are brief (they occupy together less than 22 pages) and are mainly introductory. Section I is concerned with the general subject of parasitism, resistance and immunity, pathogenicity and kindred topics. In Section II methods of preserving and mounting material are described, but the part is devoted more especially to clinical methods of diagnosing parasitic diseases. The longest part of the book is Section III, on helminth parasites (more than 230 pages), while Section IV, on arthropod parasites, occupies about 133 pages. The author evidently favours the helminths more than the arthropods, and their treatment is often more detailed, apart from the fact that they include the larger number of species of veterinary importance.

The subject matter of the book is well arranged and thoroughly up to date, while the illustrations are admirably clear and well executed and the majority of the figures are new and original. The book will undoubtedly well serve the purpose intended, and should meet the requirements of both the student and practising veterinarian. It should also be on the shelves of zoological libraries.

Qualitative Analyse mit hilfe von Tüpfelreaktionen: theoretische Grundlagen, praktische Ausfuhrung und Anwendung. Von Dr. Fritz Feigl. Zweite, verbesserte und vermehrte Auflage. Pp. xii+513. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 28 gold marks.

IT is gratifying to note that the second edition of this invaluable guide to 'spot' tests has been published within four years of the first edition (reviewed in NATURE of December 12, 1931), and that it has not been necessary to raise its price, in spite of the fact that it has been enlarged and partly rewritten. Actually, the number of pages has been increased by more than thirty per cent, much of the increase being necessary to include work, published and unpublished, carried out in the author's own laboratory.

Besides covering in the most detailed manner every variety of spot test for inorganic and for organic substances, the book contains 116 pages of theoretical discussion, under which head are considered complex-formation, co-ordination of elements, poly-acids, catalysed and induced reactions, the various groups 'specific' to particular metals and so on. Many of the tests appear twice in the book, according to whether *A* is used as specific for *B*, or *B* as specific for *A*. At the end of the book is found a tabular summary covering ten pages, an author index covering nine, and a subject index covering nearly nineteen. The utility of the book should secure for it a wide public, quite apart from its inevitable appearance on the book-shelves of every micro-chemist. A. L. B.

War Office. Textbook of Mechanical Engineering Pp. xv+690+xx. (London: H.M. Stationery Office, 1934.) 12*s*. net.

THIS is the best twelve shillings' worth of information on mechanical engineering we have ever come across, and it is scarcely possible to conceive a better guide for the young engineer. In it theory and practice are combined in an admirable manner, and it is full of those 'wrinkles' which only the experienced engineer can impart. It covers workshop practice, all the ordinary types of reciprocating steam, petrol and oil engines, boilers, power transmission, lubrication, air compressors and refrigeration. There are diagrams, tables, charts, bibliographies and a good index, and the information is conveyed with an economy of language which sometimes reminds one of the drill shed. The production of the book it may be presumed is the result of team work, but it is quite evident that a good deal of credit is due to the editor, whoever he may be. E. C. S.

A Guide to the Constellations By Prof. Samuel G. Barton and Prof. Wm. H. Barton, Jr. (McGraw-Hill Astronomical Series.) (Whittlesey House Publication.) Second edition. Pp. x+74. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s*. net.

THE first edition of this atlas was noticed in NATURE of November 10, 1928 (p. 723). In the new edition the authors have made slight alterations to the text, necessitated by recent developments such as the discovery of Pluto. The charts themselves appear to be unaltered, and the opportunity has not been taken of introducing the new constellation boundaries as defined by the International Astronomical Union. This, however, is of minor importance to the class of readers for whom the book is intended, and who will find it not only an excellent help in becoming familiar with the constellations but also a trustworthy source of elementary astronomical information.

The Medical Curriculum in Great Britain*

UNIVERSITY AND OTHER QUALIFICATIONS

TRAINING AND EXAMINATIONS

ENGLAND has been hearing a great deal about the training of medical practitioners. All through the spring months ran the long drawn examination by a Committee of the House of Lords of the evidence for and against the bill proposing that osteopaths should be accepted as medical men. The bill was withdrawn, and it may be hoped that the lay public accepted that decision with satisfaction, though it is doubtful whether they could follow the arguments of the medical experts who sought to emphasise the essential value of what was given by the orthodox medical curriculum in training the practitioners whom the country requires for its manifold services in matters of public and private health.

Now, immediately after the ending of this debate, comes a report of high authority confessing that the medical curriculum itself is in need of amendment, and proposing substantial changes. The fault here is of a very different nature and the contrast should be noted. The osteopath sought to be accepted as a medical practitioner on a scanty curriculum bent around a fundamental hypothesis of the cause of all diseases which had no relationship to the steady advances of scientific knowledge in biology.

Orthodox medicine moves forward in close harmony with every advance in modern science, gaining understanding of disease and power to control it from the physicist, the chemist, the zoologist, indeed from all except the successors of the old astrologist. Each such step forward in medical knowledge may mean the chance of its application to some individual patient, and the teacher of medicine, thinking of those patients whom his students may have to tend, feels his duty to be that no detail of possible value shall be omitted. So the student's memory is overburdened and he loses thoughtful education. The medical curriculum is not too scanty but too full.

The need for a revision of this curriculum—a rationalisation to use the latest phrase from the world of industry—has been urged again and again, by students as well as by teachers. There seems to be a greater difficulty in planning a course that shall combine education of a university type with adequate vocational training in the subject of medicine than is met with in engineering, chemistry or law. The medical man, when qualified by the final examination, is expected to be able in his independent judgment and knowledge to handle rightly one and all of the practical problems that may arise in human illness. There is no later stage of apprenticeship for him, and the routine training must be thorough and exact.

The general scheme of this training in its minimal form is outlined by the General Medical Council, a body which does not itself examine candidates or grant diplomas. Each university is free to arrange its own course of instruction and its examinations for its own degrees, provided that the standard for the latter does not fall short of the minimum prescribed by the General Medical Council. Outside London, this freedom has been used from time to time in remodelling the courses of medical education, and quite easily because each university could assemble its teachers and decide upon an agreed policy. But London in its hugeness was confronted with peculiar difficulties. The University of London contained not one but twelve medical schools, all teaching for the University degree but with teachers who until recent years did not feel inclination to obey a central University authority. Side by side with the University in the metropolis was another examining, but not teaching, body with power to grant a qualifying diploma, that of the Royal College of Physicians and Royal College of Surgeons. This Conjoint Board diploma was governed by its own curriculum, arranged in complete independence of the University of London and with its examinations graded in such a way that almost all the University of London students found it advantageous to take the Conjoint Diploma first, despite the additional and heavy fees entailed; and then a large proportion of them never troubled to complete their University course. With this alternative road to a vocational qualification lying open to its students, the University lost full liberty to make its own decisions as to the training of these men.

An added complication came from the medical schools of Oxford and Cambridge. These Universities

* Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum. Pp. ii+34. (London: University of London, 1935.)

granted a medical degree, but taught only the pre-clinical subjects. Almost all their students went for clinical training to London, to be taught in the curriculum of the University of London. Cambridge was eager for changes in the course of training, but its hands were tied because it had no power to change the routine of teaching in the London schools. Moreover, any alteration in its final examinations which might introduce difficulties for Cambridge students was open to the danger that they would simply cease to present themselves for the Cambridge degree. For the Cambridge and Oxford men, like those of the University of London, almost all secured their position in practice as early as possible by taking the separate Conjoint diploma of the Royal Colleges.

While Oxford and Cambridge were thus hindered in their desires for reform of the curriculum, London also lost some of its freedom for independent action owing to the presence of the students whom it welcomed from the older Universities. These men were not registered as students of the University of London, but Oxford and Cambridge would have felt the discourtesy if London had introduced large changes in its curriculum without inquiring how such changes would affect the course of clinical studies ordained, though not taught, by the two Universities for their students whom they sent to London. The only body that was really free for independent action was the Conjoint Board. It arranged a good practical curriculum and a sound clinical examination, though on the simple lines of a vocational training. Its demands could be less than those of a university, and it was in the position of established strength. Two thirds of the London students were content with the diploma of the Royal Colleges and never completed the University course.

These obstacles to independent action have been surmounted in the only possible way. In 1932 the Senate of the University of London invited the Universities of Oxford and Cambridge, the Royal College of Physicians of London and the Royal College of Surgeons of England to appoint representatives for a conference on the defects of the medical curriculum. The proposal was received with good will and friendliness by all. An executive committee was appointed, and in two years the Report of the Conference was issued, on April 30, 1935. Though so many bodies and so many different subjects in medical education were represented, the work of the Conference and of the Committee went forward so quietly that little discussion of the questions was excited outside the Conference itself, and the Report is signed with agreement of all its members. It is an excellent document, and the acceptance of its main recommendations and especially of its spirit by the university and other authorities concerned would improve notably the education of medical students in the metropolis. The number of the latter is larger than is commonly realised. The Medical Register shows a total of about 1,500 men and women accepted each year as newly qualified doctors. Approximately one half of this total for the whole of Great Britain receives clinical training in London. The Report has a larger responsibility than even the names of Oxford, Cambridge and London might suggest, for it considers the education of half the medical men in Great Britain.

The Report emphasises one leading principle, that education of intelligence is required, so that the student's mind may "acquire that kind of culture which survives the forgetting of facts". Again and again attention is directed to the excessive loading of the memory with details for the purpose of passing some examination which stands as a high fence before the student can pass from one closed field of the curriculum to another. Many of these facts resemble the leaden weights which a horse must carry for a handicap race, useless and discarded as soon as that particular race has been run. The Report aims at lessening the isolation of one field of knowledge from another in the progressive curriculum, seeking for example to carry physiology onward to help in experience at the bedside, while bringing illustrative material from the hospitals into the preclinical years to emphasise the aim of physiological or anatomical studies. The hope is to produce the trained intelligence, and the memory which is exact in that which must be remembered for the sudden needs of action or decision in medical work, but is not burdened with those innumerable details of secondary importance which any intelligent person would know how to find in a book when he needs them. That type of mind will not be produced unless the work of the curriculum allows reserve energy and time for thought. A lightening of the load as well as a modernisation of its content is required, and it is essential that the recommendations of the Report be judged with close attention to this primary need.

The Report does not suggest any change in the total period of medical studies for qualification, namely five years, or in its present division of two years for the preclinical period (anatomy, physiology, etc.) and three years for clinical studies. But the intermediate subjects of the preclinical years are to undergo some change. Anatomy and physiology, with biochemistry, will both receive rather less of the student's time, and they are to be illustrated towards the end of the period by

examples of derangement of normal structure or function as seen in hospital practice. In both subjects it is directed that the examinations shall not involve "burdensome memorisation of detail", structural or otherwise, but shall rather test the student's grasp of principles. Professors of anatomy and physiology are not likely to be dissatisfied with this. Their own courses of academic training for higher degrees in these subjects have generally been distinguished from that provided for medical students by the emphasis laid in examination on the comprehension and intelligence of the candidate rather than on a routine load of information. It is the type of medical examination hitherto in vogue which has insisted on minute topography or memorised physiology. But in one respect the physiologists until recently have been to blame, since they were slow to meet the needs of medical students by illustrating their science through observations on man or even on the mammal. It was once said that physiology never taught the essential facts of the catamenial period because menstruation did not occur in the frog. That reproach now belongs to past history.

Pharmacology is also eased, by attaching the subject to physiology, abolishing its special examination, and no longer requiring at this preclinical stage the purely artificial knowledge of doses of drugs and their therapeutic applications. But the leisure time that may perhaps be gained by changes in these three original subjects of the intermediate course is not left idle. Two new subjects are to be introduced, each on a minor scale. The first is an admirable choice, psychology or, as it might better be termed at this stage of the curriculum, the physiology of the mind and emotions. Eight lectures, presumably without practical experiments, are to be given and not to be followed by an examination. Medical psychology and psychiatry form a subject of immense importance both in the therapy of patients, whether physically ill or mentally afflicted, and in public health. But the subject has grown up in its own house apart from the so-called exact sciences. The medical student does not make acquaintance with it until near the end of his clinical training, and then too often in only a perfunctory way that makes him fail to grasp its high importance. In his clinical period he soon discovers that much of what is taught to him on any question in the wards lacks rigid scientific proofs, and he becomes habituated to a different set of values in the art of medicine. Psychology exists to him only in that later environment. The subject cannot but gain in strength if it is shown to be capable of a scientific exposition that will endure comparison with that of physiology, and its obvious interest may then prove powerful enough to determine some of the best of the younger men to devote their lives to the advancement of the science of mental diseases, a recruitment that is sorely needed.

The second new subject to be introduced is one which definitely links the preclinical with the clinical subjects, namely pathology in its general aspects including bacteriology. This is to be studied in the last two terms of the preclinical course, and with such seriousness that an examination in it is to be grouped with those on anatomy and physiology at the end of the preclinical course. This introduction is also a reasonable and good choice, for it prepares the student to think scientifically of disease by comparison with normal anatomy and physiology; but with the examination added it most emphatically cannot be regarded as a lightening of the curriculum at this stage. The general conceptions of pathology do not follow directly from the knowledge of normal anatomy and physiology. They are new phenomena which require time for their comprehension and some practical experience, whether this be got by laboratory experiments or by seeing human disease. Yet the student is expected to pass an examination in this new subject after a short course and at a time when he needs all his spare energy for ensuring success in the examination in anatomy and physiology which must be passed before he is allowed to move on to his clinical studies. Surely it would be wiser to give the preliminary course but to defer the examination until knowledge can ripen with fuller experience and with time for thought on that experience.

The advocates of pathology are continually increasing their claims on the medical curriculum. In 1922 the clinical period was extended from two years to its present time of three years, and that at once gave an extra year to pathology, which is taught or studied throughout all phases of the clinical period. Now, though normal anatomy and physiology are being pruned to a limited spread of growth in their short preclinical season, pathology and bacteriology are to be extended backwards for another six months, to take root in the preclinical time, to spread over all the three clinical years, and stand strongly as a separate subject in the final examination itself. One is reminded of the triumphant song of Psalm lx. "Moab is my washpot: over Edom will I cast out my shoe." But this conquest is no lightening of the burden of the curriculum, either at the beginning or the end. Academic pathology, as a science, may be more essential for the study of medicine than either anatomy or physiology, but it is difficult to justify two examinations in it when one suffices for each of the latter subjects.

The final examination in pathology, as at

present held, involves as burdensome a loading of the memory as the examinations indicated for amendment in anatomy and physiology; and it comes at a more grievous time when the student requires all the spare crannies in his memory for necessary details of clinical work. It would have been a real liberation for him if pathology had been satisfied with one examination only, about the end of his second clinical year, so that, well trained in rigid scientific thought by anatomy, physiology and pathology successively, he could then devote himself to his final clinical subjects and, under the guidance of clinical teachers who would also be his examiners, prove his intelligence in the application to medical problems of these fundamental scientific subjects. A modern clinician in a good hospital, whether he be surgeon or physician, is guided in all his thoughts by applied physiology and pathology: indeed he is more alert to employ physiological knowledge for the investigation of clinical problems than is the pathologist, who tends to restrict his outlook to morbid anatomy and immunology. It is essentially the clinician's duty to apply in his work the principles derived from the sciences of physiology and pathology, and to explain their application to the student when the latter has learned these sciences in their academic aspect apart from the individual patient. If the clinical teachers cannot use this knowledge in his work, the student will be driven to think that it is all artificial and a weariness added to his mind. It is not reasonable to impose at the end of the clinical period a separate examination controlled by pathologists who are likely to demand from the student, just when he is maturing to clinical skill, a greater load of pathological information than he or even a senior clinician can employ in work with patients.

For the clinical work of the final three years the Report has no considerable changes in view. It stresses that more attention should be given to attaining practical familiarity with minor ailments and with common diseases of the skin, eye and ear, which tend to be segregated in special departments of a hospital. The required time may be found in curtailing that of attendance on such major operations as in later practice will fall only to the surgical specialist. Emphasis is rightly laid on the need for fuller practical instruction in the psychological aspects of ill health; and a special course of lectures is demanded for public health and State medicine, including forensic medicine. All these are additions obviously needed for the education of the ordinary practitioner, but nothing has been put aside to make room for them.

The most fundamental change of all in the clinical period is that recommended for the sequence of the final examinations. Hitherto obstetrics and gynæcology have been grouped as a small subject, easily methodised in teaching, and often cleared away by the student as a preliminary to his more serious approach to medicine and surgery. That meant a lower standard of skill in a subject where recent developments in public health services have actually been tending to require that the practitioner shall at once be competent to assume the position of a consultant with ripe experience. So the order of examinations has been reversed, and obstetrics together with diseases of children and State medicine are to form a senior subject in Part II of the final, which cannot be passed until the student has completed his examination of medicine and surgery. This change would undoubtedly fit the doctor better for his important duties in relation to national health, though actually it cannot but constitute an increase in his curriculum, because a higher standard of knowledge will be demanded for subjects that at present are treated too lightly. The Report offers no advice as to the time when these different examinations may be attempted in the final period, but it is assumed that all can be completed by the end of the three years.

The formal decisions now lie with the Universities and the Conjoint Board. If the recommendations of the Report are generally accepted, the education of the doctor will be more intelligent and far better adapted to the needs of modern practice. But the examiners will still be waiting at the Caudine Forks. Unless they alter their present attitude and in advance of the examinations reassure the student that the change is real, he will continue to load himself as before with every odd scrap of knowledge that he fancies may be called for at his trial. Then the new subjects will be found to have added to the present burden of the curriculum and all will be heavier still. Someone recently compared the weight of kit carried by the British infantry soldier in comparison with his body weight and muscle to that which is the regulation maximum for horse and camel in the same scale of comparison. The infantryman would be fairly loaded at 30 lb., but his determination enabled him to struggle along with twice that weight as modern science altered warfare and new devices were continually added to his original kit. The medical student is in a like plight, and he too carries on. The difficulties of his toil have been recounted by the Dean of St. Mary's Hospital, Dr. C. M. Wilson, in an article justly entitled "The Student in Irons"*. If the examiners accept the spirit of the present Report, they can do much in helping to unshackle a very willing worker.

T. R. E.

* *British Medical Journal*, March 12, 1932.

Biological Control of Coconut Scale in Fiji*

SUCCESSFUL INTRODUCTION OF A COCCINELLID BEETLE

By Dr. A. D. Imms, F.R.S.

MR. T. H. C. TAYLOR has recently prepared a lengthy paper describing biological methods of controlling the scale insect *Aspidiotus destructor* in Fiji. From the economic point of view, this pest causes extensive damage in Fiji to coconuts, bananas, 'yagona' and avocado. The present paper deals more especially with the insect in relation to the copra industry, of which it is a most serious enemy.

It is not known how, or exactly when, the scale insect became introduced into Fiji; but it was already a pest in the year 1912. Neither chemical nor mechanical methods of control for insects attacking coconuts can be satisfactorily employed in the islands on account of labour being expensive and relatively scarce. Furthermore, the coconut estates are not sufficiently localised to allow of a power sprayer being used without incurring excessive costs for transportation. Attempts were made to control the *Aspidiotus* in 1920, when certain parasites were introduced from Tahiti, notably the species *Aphelinus chrysomphali* and *Aspidiotiphagus citrinus*. In 1927, other parasites and also certain predators were imported from Java, but neither of these schemes of parasite introduction proved productive of appreciable economic results.

It was not until 1928, when several species of predators were obtained from Trinidad and introduced into Fiji, that a solution of the problem was obtained. The fact that certain Coccinellid beetles had been observed to be important factors in the repression of the *Aspidiotus* in Trinidad led to five species of the family being introduced into Fiji. The metamorphosis and biology of these insects are carefully described and figured. Of these, *Cryptognatha nodiceps* proved far superior as a controlling agent to any of the other four species, and attention was mainly centred upon it.

As a means of controlling the *Aspidiotus*, *C. nodiceps* proved to be a remarkable and spectacular success. Only nine months after the shipment was landed in Fiji, and liberations made, the scale insect was brought under control in all the more important islands of the group. After a further nine months, the scale was not only controlled on every single island, but also became so rare in many localities where it formerly abounded that living batches could only be found after much searching. Up to the time of writing his paper (July, 1934), Mr. Taylor states that the Coccinellid has not only reduced the appearance of the scale to negligible proportions, but is also apparently maintaining a permanent effective check upon it.

The complete success of the introduction of *C. nodiceps* is attributable to a combination of facts. First, it breeds continuously with a high rate of multiplication throughout the year in Fiji. It is a voracious predator, both as larva and adult, and in the latter phase it is long lived. Secondly, it has remarkable powers of dispersal. Thirdly, it has no serious natural enemies in Fiji. Finally, the *Cryptognatha* is able to survive even when the *Aspidiotus* has become reduced to a condition of great scarcity. In this connexion, the fact that it has an alternative host in another scale insect, namely, *Diaspis pentagona*, which is not a serious pest in Fiji, is important.

When a parasite or predator is introduced into a new country, where the *Aspidiotus* is rampant and occurring in outbreak form, it must be capable of multiplying and dispersing sufficiently rapidly to 'overtake' the pest in the worst outbreak. Also, having repressed the scale to an economically negligible condition, it must be capable of maintaining such a phase. It appears that none of the parasites previously introduced is capable of fulfilling these conditions and was consequently foredoomed to failure. Each individual parasite can only destroy one individual pest and none is capable of greater multiplication than the latter. It is only an insect like *C. nodiceps*, of quite exceptional voracity and with a very high multiplication rate, which can possibly control the outbreaks in question. Each individual *nodiceps* is capable of destroying hundreds of scale insects, in all stages, during its life and of bringing about a far greater destruction rate than that achieved by any of the parasites. Whereas the latter, theoretically at least, are capable of maintaining the scale in a non-outbreak condition, their biological attributes are such that they are inherently incapable of bringing about that condition in the first place.

* "The Campaign against *Aspidiotus destructor*, Sign. in Fiji." By T. H. C. Taylor (with three sections by R. W. Paine). *Bulletin of Entomological Research*, 26, 1–102, with 40 text-figures; 1935.

Obituary

Dr. Herbert H. Thomas, F.R.S.

THE sudden death on May 12 of Dr. Herbert H. Thomas, petrographer to H.M. Geological Survey, at the early age of fifty-nine years, has caused a sad gap in the ranks of British geologists, and deprived a large circle of a warm friend and helpful adviser. To brilliant academic attainments he added further lustre during his subsequent geological career. His wide interests and accurate knowledge were readily placed at the service of those who consulted him, and his sympathetic nature made him an unusually large circle of friends. To know Thomas was to love him.

Educated at Exeter School, where his family then lived, Thomas entered Sidney Sussex College. In due time he obtained a first class in Part I and in Part II of the Natural Sciences Tripos; was awarded the Harkness Scholarship (1898) and the Sedgwick Prize (1906). In 1898–1901 he acted as assistant to Prof. W. J. Sollas at Oxford. In 1901 he was appointed geologist on H.M. Geological Survey and was assigned to the South Wales district; just at the time when the classic district of Llandeilo was about to be entered by the surveyors.

Thomas, trained at Cambridge, had the good fortune to be associated with T. C. Cantrill, who was a pupil of Lapworth at Birmingham. Both these officers had been imbued with the work of Lapworth and of Marr and others of the Cambridge School on the Lower Palæozoic rocks. At the same time, Sir Jethro Teall had been appointed director of the Survey. The conditions were therefore exceptionally favourable to the adoption by the Geological Survey of Lapworth's threefold classification of those rocks which is now in universal use in place of Murchison's classification, previously used on its maps and in its memoirs. Thomas remained on the field staff until the completion of South Wales in 1911, when he was appointed petrographer—a post for which his training and interests in mineralogy eminently fitted him. He retained, however, a keen interest in the older rocks of South Wales, and frequently returned to attack their problems. Several papers appeared in the *Quarterly Journal of the Geological Society* jointly with O. T. Jones and with A. H. Cox.

In later years, Thomas's official duties brought him into intimate contact with the officers of the Scottish branch of the Geological Survey who were engaged in examining the Tertiary igneous rocks of the west of Scotland. When he was president of Section C of the British Association in 1927, he gave a brilliant address on the Tertiary volcanic history of north-west Britain. His interest in mineralogy, which had begun in his youth among the mine-heaps of Cornwall and Devon, was maintained throughout his career, as instanced by his valuable contributions on the minerals of the Trias of the south-west of England and papers on minerals and optical apparatus which were contributed to the Mineralogical Society, of which he was an active member.

Largely through association with T. C. Cantrill, Thomas took a keen interest in prehistory, and his wide knowledge of igneous rocks and their distribution was readily placed at the disposal of many visitors to the Geological Survey offices in Jermyn Street, who brought for investigation, stones, axes and other objects of archæological interest. By his fortunate acquaintance in the field with the igneous rocks of Pembrokeshire, he was able conclusively to solve the mystery of the blue-stones of Stonehenge, which had previously been assigned to many and diverse sources, and to show that they had been derived from a small area surrounding Carn Meini in the Precelly range.

Thomas was awarded the Murchison Medal in 1925 by the Geological Society of London, of which he was secretary from 1912 until 1922 and vice-president from 1922 until 1924. He also served on the Council of the Mineralogical Society. He was elected to the Royal Society in 1927, and at the time of his death was on the Council. He is survived by his widow, one son and one daughter.

Mr. J. E. QUIBELL

THE death is announced of James Esward Quibell, well known as an Egyptologist, at the age of sixty-eight years. Born at Newport, Shropshire, he was educated at the Newport Grammar School and at Christchurch, Oxford, of which he was an exhibitioner. After taking honours in Classical Moderations and the Final School of Natural Science, he engaged for a time in teaching; but travel in Egypt attracted him to archæology. He joined Prof. Flinders Petrie, assisting in the excavation of Coptos, Nagada, El Kab, Hierakonpolis and other sites. After a brief period of study at Berlin, he was appointed to the Catalogue Commission of the Egyptian Museum, Cairo, and in 1899 became an inspector in the Egyptian Antiquities Department.

Quibell conducted excavations in Upper Egypt and at Saqqara for a number of years and then in 1913 was made keeper of the Egyptian Museum, a post which he held until his retirement in 1925, although for the last two years of his tenure he acted as Secretary-General to M. Lacau, Director-General of Antiquities. Two years later he suffered serious loss in the death of his wife, a daughter of Principal Pirie of the University of Aberdeen, herself a distinguished archæologist. Notwithstanding the break in his life occasioned by this loss, he continued to pursue his archæological studies in Egypt almost to the end. He leaves behind him a record of sound and methodical work which has not always been so widely or so fully recognised as it deserves.

News and Views

Dr. Bernard Smith and the Geological Survey

DR. BERNARD SMITH, who has been appointed to succeed Sir John Flett as director of the Geological Survey of Great Britain, joined the Survey as a geologist in 1906, became district geologist of the Cumberland Division in 1920, and was appointed assistant to the director in 1931. In 1902 he had entered Sidney Sussex College, Cambridge, where his uncle, Charles Smith, author of many well-known books on mathematical subjects, was master. Taking a first class in both parts of the Natural Sciences Tripos and gaining the Harkness Scholarship for geology in 1906, he maintained his College's fine record for producing first class geologists. The Harkness Scholarship has been won by Sidney men six times since 1893. Bernard Smith's work on the Geological Survey and his researches pursued during vacations earned him a Geological Society award in 1913 and the Bigsby Medal of that Society in 1927. He was elected a fellow of the Royal Society in 1933. He is the author of many papers on stratigraphy and on the glaciology of Cumberland and North Wales, of many contributions to the memoirs of the Geological Survey, and of a well-known textbook of physical geography. His work on the Survey, particularly on the coal and iron-ore deposits of Cumberland, has brought him into contact with practical problems in which the Geological Survey and its Museum are so closely concerned. We may congratulate him on being selected to direct the progress of the Geological Survey in the first year of the second centenary of its work, and it may augur well that the new director, chosen at this historic moment in the life of the Survey, bears the name of the "father of English Geology", William Smith.

Prof. A. P. Karpinsky and the U.S.S.R. Academy

AMONG the delegates present at the recent celebration of the centenary of the Geological Survey of Great Britain was the veteran geologist, Prof. A. P. Karpinsky, president of the U.S.S.R. Academy of Sciences, Leningrad. Prof. Karpinsky is well known to British geologists, and was elected a foreign correspondent of the Geological Society of London so long ago as 1898. He became a foreign member of the Society in 1901 and received the Wollaston Medal in 1916. He is now in his ninetieth year, and has been a member of the Academy of Sciences in Leningrad for nearly fifty years, and its president for twenty years. The honorary members of this Academy include Sir F. G. Hopkins, Lord Rutherford, Sir Charles Sherrington and Sir Robert Hadfield. At a small luncheon given by Sir Robert Hadfield on July 10 in honour of Prof. Karpinsky, at which there were present, among others, Sir F. G. Hopkins, president of the Royal Society, Prof. W. W. Watts, president of the British Association, and Sir John Flett, director of the Geological Survey, Sir Robert recalled that Faraday was an honorary member of the Academy. He added: "As a metallurgist, I can speak with the highest approval of the splendid work of the two famous Russian scientists of the past, Demetri Tchernoff, who I believe was a member of the Academy, and Sergius Kern. From the research work of both these metallurgists I greatly benefited in my younger days." After the luncheon, the guests had an opportunity of seeing some interesting exhibits brought together by Sir Robert Hadfield, including a model in modern rustless steel of the famous iron pillar at Delhi, Mr. F. J. Halnon's bronze group symbolising "A Legend of Metallurgy", and objects illustrating results of investigations of specimens of steel made by Faraday at the Royal Institution between the years 1819 and 1824 and described in Sir Robert's book "Faraday and his Metallurgical Researches".

South African Protectorates and British Pledges

MINISTERS of the Crown have shown a somewhat tardy but earnest desire to allay public uneasiness lest further steps should be taken to carry out the undertaking of the British Government to hand over the three South African native protectorates to the tutelage of the Union Government without any opportunity being given for the expression of the views of the native population on the proposed transfer. The ground for this fear has now been removed by an official reaffirmation of the pledges given when the South Africa Bill passed through Parliament. In the *aide-memoire*, which was handed to the Prime Minister of the Union of South Africa by the Secretary of State for Dominion Affairs on May 15 last, now published as a White Paper (Cmd. 4948), explicit reference is made to the undertakings that the inhabitants, both native and European, of the Protectorates would be consulted, and Parliament given an opportunity to express its views, as precedent conditions which must be observed before transfer takes place. This memorandum goes on to state that the Government has expressed its view to General Herzog that not only is the time not ripe for such consultation of the inhabitants, but also that the information at its disposal indicates that native opinion in the territories is very strongly opposed to the transfer. This statement will bring reassurance to those who have felt apprehension at the way in which the situation has appeared to be developing in the last twelve months, and also it will give them no little gratification by its firm, but at the same time conciliatory, attitude in asking for the co-operation of the Union Government with the administration of the territories during the next few years in a policy which will convince the native population that the Union Government is working with the local administration in a real and generous desire to develop and improve conditions in the territories.

Committee Against Malnutrition

THE Committee against Malnutrition has issued for publication a memorandum which has been sent to the Advisory Committee on Nutrition of the Ministry of Health. The Committee considers that the full application of modern advances in the knowledge of nutrition would effect a general raising of the standard of health comparable to that which followed the lessening of disease by the construction of an adequate system of public sanitation. It is necessary not only to provide food of good quality, in sufficient amounts, but also to ensure the correct relation between the component foodstuffs. This can only be done by allowing an appreciable margin over any minimum standard hitherto formulated: the Committee considers that there is evidence that many lowly paid and unemployed families cannot purchase enough food to allow such a margin. The purchase of foodstuffs of special value will be at the expense of the cheaper energy-producing foodstuffs; dietary studies have shown that the change over to vitamin-rich food takes place automatically with increasing income. The addition of vitamin concentrates to the diet is deprecated. The Committee recommends that the precise food values of commercial preparations should be published by the Advisory Committee on Nutrition of the Ministry of Health, and that processing and dyeing foodstuffs should be prohibited. The view is put forward that all school children should receive half a pint of milk a day and nursing and expectant mothers at least one pint, with a scale of charges on a fair income basis. The Committee also expresses the opinion that the notion of minimum diets should be condemned.

Vitamin Standards

AT the request of the Health Organisation of the League of Nations, the Board of Trustees of the United States Pharmacopœia has consented to make generally available the standard cod-liver oils, prepared for use in the United States as secondary standards for vitamins A and D. The distribution of these oils will not be made through the national distributing centres as in the case of the primary vitamin standards, but direct to individual users. They may be obtained from Mr. E. Fullerton Cook, Chairman of the Committee of Revision of the U.S. Pharmacopœia, 43rd Street and Woodland Avenue, Philadelphia, Pa., U.S.A. It should be clearly stated whether vitamin A oil or vitamin D oil is required. A charge of 2.50 dollars is made for containers holding 30 c.c. A sum to cover the cost of the quantity required should be sent by international money order with the application. The oils will be sent post paid to their destinations. These reference oils are checked each six months biologically against the international standards by at least six laboratories, and their potency should therefore be increasingly dependable. Secondary standards of vitamins A and D are of considerable importance to British users, as it has not been possible to supply the primary international standards of these vitamins in quantities sufficient to enable them to be used for routine assays.

The Hæmatopoietic Liver Substance

THE *Yorkshire Post* of July 9 directs attention to the recent isolation by Dr. H. D. Dakin, who is a former student of the Yorkshire College in Leeds, and West, of a substance effective in causing blood regeneration in pernicious anæmia; the paper describing the investigation is published in the *Journal of Biological Chemistry*, vol. 109, p. 489; 1935. The material is obtained from liver extract by precipitation with Reinecke acid; the precipitate is decomposed with the aid of dimethylaniline and the active principle afterwards purified by salting out with ammonium and magnesium sulphates and sodium chloride. It appears to be of protein nature: on hydrolysis, an aminohexose similar to glucosamine was isolated together with lysine, arginine, glycine, leucine, hydroxyproline and aspartic acid; cruder preparations also contain histidine, glutamic acid and possibly traces of phenylalanine. Pepsin hydrolyses it to a slight extent, erepsin completely though slowly. The compound produces a good reticulocyte response in cases of pernicious anæmia in doses of 80 mgm. when given by subcutaneous or intravenous injection. Dakin and West's paper indicates that a distinct advance has been made in the problem of isolating the liver principle active in pernicious anæmia.

Broadcasting and the Jubilee Naval Review

FEW events of outstanding national interest now take place unaccompanied by a broadcast commentary. The Silver Jubilee review of the Fleet by His Majesty the King provided yet another demonstration of the use and efficiency of the national broadcasting service by distributing an eye-witness account of the scene and action of the review at the actual time of the event. On this occasion, the series of broadcasts was given by two naval officers located at the foretop on board H.M.S. *Royal Sovereign*, one of the ships taking part in the review, and occupying a very advantageous position from the commentators' point of view. A short-wave portable radiotelephony transmitter installed in the *Royal Sovereign* was used for the purpose of communicating the commentary to a receiver suitably located at Southsea Castle on the mainland. The signals thus received were transmitted by land-line to Broadcasting House, whence they were distributed in the ordinary way through the National stations. The programmes broadcast included a description of the scene at Spithead on the night preceding the review, with the 160 or so ships of all classes correctly assembled in position. On the actual day of the review, July 16, separate commentaries were arranged to describe the scene when H.M. the King received the Royal Salute, and then proceeded to sail up and down the lines of battleships; and finally at night a description of the illuminations of the fleet and the firework displays was given from the vantage-point of the *Royal Sovereign*. Four microphones were employed to pick up the gun salutes, cheers of the ships' crews and other characteristic sounds. As is now usual on such occasions, suitable recordings were made of the programmes to enable these to be repeated later, particularly for the benefit of Empire listeners.

A New Subtractive Colour Film

THE Eastman Kodak Company has introduced a new 16 mm. cinematograph colour film. This is known as the Kodachrome film. It differs from many other colour films now available in that the colour effects are produced 'subtractively'. The superimposition of 'minus' colours is used to yield the final colour. For example, a blue is produced by placing a minus green (magenta) on a blue-green (minus red), green by minus blue (yellow) on a minus red and so on. This is, of course, the ordinary principle of three-colour printing, but to apply it to this process has involved the use of a film coated in three layers. Each of these layers records one of the primary colours only. The top layer is sensitive to blue and transmits only green and red; the second layer records green and transmits red, while the last layer of all records only red. The film is exposed in the ordinary way and has a sensitivity which is said to be about half that of the normal film used for black-and-white cinematography. Processing is divided into a number of separate processes: (1) Development to negative. (2) Bleaching and clearing to get rid of the developed silver. (3) Exposure and redevelopment to positive. This redevelopment is carried out with a 'dye-coupling developer' which attaches a blue-green dye to the silver produced by development. All three layers are treated indiscriminately up to this point. Then follow further stages. (4) Bleaching the two upper layers; silver chloride is formed in place of the silver in these layers and the blue-green dye in them is destroyed. (5) Exposure and redevelopment of the two upper layers with a magenta coupling developer. (6) Bleaching the top layer and destroying the magenta dye. (7) Exposure and development of the top layer with a yellow coupling developer. The pictures so formed are continuous in tone.

Spelæological Research in Great Britain

A PROPOSAL to form a central organisation for the co-ordination of research in the caves and pot-holes of Britain is to be discussed at an inaugural meeting to be held on July 27 at the Museum, The Wardwick, Derby. Among those taking an active part in forwarding the movement are Prof. L. S. Palmer (Hull), Mr. A. Leslie Armstrong (Sheffield), Dr. J. W. Jackson (Manchester), Dr. A. Raistrick (Durham), Mr. H. Brodrick (Birkdale), and Mr. C. R. Hewer (Bristol University Spelæological Society). Prof. L. S. Palmer will act as chairman of the meeting, when aims and methods which will best promote systematic exploration of British caves on comprehensive lines, embracing all relevant forms of evidence, will be discussed. The proposal most favoured at present is the constitution of a British Spelæological Association, which would lead the way to a standardisation of technique and afford opportunity for co-ordination of results. Cave exploration in Britain has by no means been neglected, as the exploration of Kent's Cavern, Torquay, and Boyd Dawkins' classic work on "Cave Hunting" bear witness. The pot-holes clubs and antiquarian societies of the north of England have devoted considerable attention to it, and the activities of the Bristol University Spelæological Society, Mr. Leslie Armstrong and Prof. Palmer have been remarkably fruitful in additions to archæological knowledge, especially of the palæolithic period. It is felt, however, that co-operation between individuals and organisations interested in the problems of cave-dwelling man and his environment will facilitate further research and preserve the enthusiasm of explorers from unprofitable, and even harmful, activity by ensuring greater uniformity in the observance of scientific methods of exploration—a view in which archæologists, at least, will heartily concur.

Lulham Memorial Fund

MISS ROSALIE LULHAM, who died on December 28, 1934, was well known as a field naturalist and for her work as a teacher of natural history. During the last year of her life she was actively concerned in planning a course of training in natural history for students, teachers and others with previous scientific training, who, to quote her own words, "wish to make that practical study of living things both outdoors and indoors, which would enable them to teach live Natural History, making it the absorbing and enlightening subject it may be". Such a course of training is being established at the Froebel Institute, where she worked for thirty-eight years, and where the tradition of her teaching is living and growing in the Natural History Department built up by her efforts. The College of the Institute at Roehampton Lane, London, S.W.15, with its spacious grounds and its proximity to Richmond Park, offers excellent scope for practical study in natural history, and it has been suggested that a Lulham Memorial Fund be opened with the object of equipping the Science Department for advanced study in natural history. We trust that this appeal will meet with ready response not only from those who, directly or indirectly, shared the inspiration of her teaching, but also from those who believe that there is a real educational need for encouraging the teaching of biology through the study of living Nature. Donations should be sent to Dr. A. B. Rendle, c/o British Museum (Natural History), Cromwell Road, London, S.W.

Television in the Cinema

CAPTAIN A. G. WEST, of the Baird Television Co., Ltd., gave a very instructive address to the Cinematograph Exhibitors' Association at Cardiff on June 26. A summary of this address appears in the *Electrician* for July 5. He pointed out that the only possible waves that can be used to produce high-definition pictures are ultra-short waves the lengths of which are not greater than 10 metres. If a 6-metre length is used, then the necessary breadth of the band need be only between 5·9 metres and 6·1 metres. If it be operated on 300 metres, it would interfere with many of the broadcasting stations in Europe. Ultra-short waves have almost the same properties as waves of light and thus cast shadows. The transmitting aerials on the top of the Crystal Palace tower are

700 ft. above sea-level and in most directions give an effective range of transmission of about 40 miles. In his opinion, the best all-round wave-length for television is 7 metres, which does to a certain extent curve round hills to more distant points. A large number of tests have been carried out in all parts of London in receiving pictures from the Crystal Palace transmitter. Excellent pictures have also been received at some fifty sites ranging from Southend to Maidenhead and from Hatfield to Sevenoaks. In two years time, it may be possible to buy a complete set for the home for about 35 guineas. For cinema work, he thought that the best method is to use an intermediate film. A film is taken of the scene to be transmitted. It is then developed, fixed, washed and dried before being televised, the whole operation being less than two minutes. The first cinemas to receive their programmes by television would get them by radio transmission links. Later on, the big central radio transmitter might conveniently be replaced by a central distributing exchange point, which would receive the televising waves by cable from the outside point possibly twenty miles away.

Italian Breakwater Construction

On July 9, at the invitation of the Council, a special lecture, illustrated by lantern views, was delivered at the Institution of Civil Engineers, by Prof. E. Coen Cagli, of the School of Engineering of Rome. Prof. Cagli reviewed very exhaustively the progress made during recent years at Italian harbours and gave particulars of the present accommodation and equipment at the leading ports. He related how, on his recommendation, following an official visit a number of years ago to Great Britain for the purpose of studying British methods and practice, the vertical wall type of breakwater came to be adopted in Italy, and he stated that, with the exception of an unfortunate experience at Catania, attributable to absence of vertical bond in the structure, the results had been uniformly successful. He described the catastrophic storm of March 26–27, 1933, which caused the displacement of 700 lineal metres of newly constructed breakwater at that port and compared it with the similar catastrophe which befell the second arm of the Mustapha Jetty at Algiers on Feb. 2–3 of the following year (vide NATURE, **135**, 143, Jan. 26, 1935), giving it as his opinion that these two incidents, on an analysis of the attendant conditions, only served to confirm his judgment in favour of the vertical wall breakwater. This type, moreover, had received further support from a series of experimental tests with small scale models, which he had been conducting with the co-operation of Prof. Stuckey at the hydrological laboratory of the University of Lausanne. Prof. Coen Cagli closed his lecture with a statement of the series of conclusions at which he had arrived on the basis of his experimental investigations.

Foundation for Theoretical Biology at Leyden

To promote the study and work in the field of theoretical biology, a foundation for theoretical animal and human biology has been established at the University of Leyden. In memory of Van der Hoeven (1801–68), professor of zoology in the University and author of the "Philosophia Zoologica", it is called "Prof. Dr. Jan van der Hoeven Stichting voor theoretische biologie van dier en mensch". The chief objects of the foundation are: (1) to arrange for lectures at the University of Leyden; (2) to bring Leyden biologists who are interested in theoretical biology into contact with their colleagues in Holland and abroad; and to promote the co-operation of theoretical biologists all over the world, for example, by arranging international symposia on theoretical biology; (3) to publish articles on theoretical biology; (4) to found a library on this subject. The directors of the Foundation are: Dr. C. J. van der Klaauw, professor of general zoology at the University of Leyden, Dr. J. A. J. Barge, professor of medical anatomy at the University of Leyden, and Dr. Adolf Meyer, professor of theoretical biology at the University of Hamburg.

U.S. Stratosphere Balloon *Explorer II*

MISFORTUNE has attended this latest attempt at stratosphere research. An account of the careful preparations that had been made jointly by the National Geographic Society and the U.S. Army Air Corps appeared in NATURE of June 22 (p. 1026) and the largest balloon ever designed was scheduled to be ready by June 1. A message in *The Times* of July 12 reports, however, that whilst the gondola was being attached on the previous day, the balloon burst for some unaccountable reason; the 375,000 cu. ft. of helium were lost, and the five men working below had to jump for their lives to escape from the falling mass of the collapsing envelope. From the brief report it would appear as though the whole of the 8 tons upward force was too much for the initial cylindrical form assumed by the envelope, with the result that the top blew out.

The New York Aquarium

THE thirty-eighth annual report of the New York Zoological Society includes the report of the director of the Aquarium, Mr. Charles M. Breder, Jr., assistant director (June 1934). Some of the larger exhibits, including aquatic mammals, have been discontinued, but there is a larger number of fishes, so that the total number of species and specimens is greater than before. The work of the laboratory for the most part was concerned with studying various details of aquarium operation for the improvement of life conditions of fishes in captivity, including water chemistry, control of parasites and bacteria, food and breeding. A new antiseptic, 'mesthiolate', was found to be of distinct value in the control of secondary bacterial infection and in overcoming attacks of the protozoan *Costia*. Young brine shrimps, *Artemia salina*, reared from dried eggs supplied by the San Francisco Aquarium Society, have proved an excellent food for the sea-horses and other small fishes. With some little trouble, the shrimps may be raised to a considerable size suitable for larger species.

'Spot' Tests

THE British Drug Houses, Ltd., London, N.1, has recently published a fourth edition of its book of reagents for 'spot' tests and delicate analysis (2*s*. 6*d*., postage 4*d*.). The application of sixty-seven organic reagents is described, nearly twice the number given in the first edition which was issued three years ago. References are appended to each monograph. In addition to descriptive matter relating to 'spot' tests as applied to micro-analyses, the book includes adequate working details for many colorimetric determinations and larger scale methods of analysis in which organic reagents are employed. This firm also makes a 'spot' test outfit and issues a price list of the reagents mentioned in the book. The fact that the latter has reached a fourth edition in three years indicates that the use of these reagents is extending.

Congress of Phonetic Sciences

THE second International Congress of Phonetic Sciences will be held in London on July 22–26, when the following subjects among others will be discussed: the physiology of the voice, evolution of speech in the individual, its evolution in the history of mankind, influence of heredity, gesticulation, psychology of speech, the deaf-mute, problems of practical instruction in language, use of the gramophone, and speaking films. Further information can be obtained from Miss Parkinson, International Phonetic Congress, University College, W.C.1.

International Congress on Population Problems

AN International Congress for the Scientific Investigation of Population Problems will be held in Berlin on August 26–Sept. 1 next. Arrangements for the Congress are being made by the International Population Union in association with the German societies for the study of race, hygiene, statistics and public health. The president of the Congress is Dr. Eugen Fischer, director of the Kaiser Wilhelm Institute for Anthropology, Human Heredity and Eugenics, Berlin. The scientific proceedings of the Congress will be conducted in general and sectional meetings, the latter providing for communications dealing with population statistics, population biology and race hygiene, social, economic and psychological population problems, and medicine and hygiene. Specific topics of discussion are "The Problem of Births", "Town and Country", "Racial Hygiene", and "The Protection and Consecration of Life". The General Assembly of the International Union for the Scientific Investigation of Population Problems will be held on Monday, August 26, under the presidency of Sir Charles Close. The delegates will be received by the Government of the Reich, the city of Berlin, and the Oberbürgermeister of Potsdam. Visits will be paid to scientific institutions, labour corps camps, etc., and arrangements have been made for an excursion to Saxon Switzerland. Particulars of the arrangements for the Congress may be obtained from the central office, Einemstrasse 11, Berlin, W.62.

Beit Memorial Fellowships for Medical Research

AT the meeting of the trustees of the Beit Memorial Fellowships for Medical Research on July 12, it was announced that Prof. T. R. Elliott, professor of medicine in the University of London, and Prof. E. D. Adrian, Foulerton research professor of the Royal Society, have been appointed trustees in succession to the late Sir John Rose Bradford and to Sir Charles Sherrington respectively. Elections to fellowships were made as follows, the proposed subject and place of research being given in each case after the new fellow's name. *Senior Fellowship* (value £700 per annum): Mr. R. Hill, to continue his studies on the respiratory function of hæmoglobin (Physiological Laboratory and the Molteno Institute, University of Cambridge). *Fourth Year Fellowships* (value £500 per annum): Dr. R. Gaddie, to continue his research on the metabolism of heart muscle (Departments of Medical Chemistry and Materia Medica, University of Edinburgh); Dr. J. M. Robson, to continue his work on the hormonic factors concerned in the maintenance of pregnancy and initiation of parturition (Institute of Animal Genetics, University of Edinburgh, or the School of Agriculture, University of Cambridge); Dr. F. G. Young, to study the diabetogenic factors of the anterior pituitary gland (Department of Physiology and Biochemistry, University College, London). *Junior Fellowships* (normal value £400 per annum): Dr. A. R. Todd, molecular structure of vitamin B_1 (Department of Medical Chemistry, University of Edinburgh); Mr. R. J. Kellar, the problem of nephritis and high blood pressure associated with pregnancy (London laboratories of the Royal College of Surgeons, and the Obstetric Unit, University College Hospital, London); Mr. N. L. Edson, fat metabolism and ketogenesis (Institute of Biochemistry, University of Cambridge); Dr. M. H. Salaman, investigation of the antigenic structure of the vaccinia virus (Lister Institute of Preventive Medicine, London); Dr. J. D. Fulton, experimental chemotherapy of malaria (London School of Hygiene and Tropical Medicine); Dr. Adèle H. Rosenheim, chemical nature of antibodies, especially those in antityphoid sera (Lister Institute of Preventive Medicine, London). The honorary secretary of the Beit Memorial Trustees is Prof. T. R. Elliott, University College Hospital Medical School, University Street, London, W.C.1.

Leverhulme Research Fellowships and Grants

TWENTY nominations have been made to Leverhulme Research Fellowships tenable for varying periods up to two years. The new fellows and their subjects of research include the following: Dr. W. N. Bailey, senior lecturer in mathematics, University of Manchester, the study of functions of hypergeometric type; Prof. D. B. Blacklock, professor of tropical medicine, University of Liverpool, a study of the present practice of hygiene (including rural hygiene) in certain Eastern countries; Mrs. M. G. Blacklock, curator of the Museum, Liverpool School of Tropical Medicine, a comparative

study of the organisations for the improvement of health of women and children in Eastern countries; Prof. C. Daryll Forde, professor of geography and anthropology, University of Wales, Aberystwyth, field study of the economy of a West African village community; Mr. S. D. Garrett, formerly assistant plant pathologist, Waite Agricultural Research Institute, University of Adelaide, the biological antagonism of the soil microflora towards root disease fungi of crop plants; Mrs. M. M. Hasluck, the unwritten law of Albania; Mrs. K. Lonsdale, research worker, Royal Institution, relation between structure and physical properties of organic molecules; Mr. E. P. Mumford, late director, Pacific Entomological Survey, Honolulu, terrestrial and freshwater biota of the Marquesas Islands; Dr. R. G. W. Norrish, Emmanuel College, Cambridge, the mechanism of certain chemical reactions; Mr. F. R. Perry, Research Dept., Metropolitan-Vickers Electrical Co., Ltd., the study of overvoltages due to lightning on transmission lines; Mr. L. R. Wager, lecturer in mineralogy and petrology, University of Reading, the tertiary igneous history of East Greenland; Mr. W. D. Ware, washery supervisor, Cefn Coed Colliery, Crynant, South Wales, research on the lower part of the Coal Measures and Millstone Grit in Pembrokeshire.

SEVEN grants in aid of research have been made by the Leverhulme trustees. They include grants to the following: Dr. P. Ford, head of Department of Economics, University College, Southampton, for statistical inquiries into sources of family income; Mr. R. D'Oyley Good, head of Department of Botany, University College, Hull, for a botanical survey of Dorset; Prof. J. W. Heslop Harrison, professor of botany, Armstrong College, Newcastle, for genetical and evolutionary studies with special reference to closely allied species and local races; Mr. J. W. Layard, to study the social anthropology of north eastern Malekula and allied cultures; Prof. J. W. W. Stephens, emeritus professor of tropical medicine, University of Liverpool, for a treatise on blackwater fever in its historical, clinical and other aspects.

Announcements

THE fifth Congress of Biological Chemistry will be held at Brussels on October 23–25. Further information can be obtained from the general secretary, M. R. Fabre, 149 rue de Sèvres, Paris.

IN a recently published pamphlet entitled "The Wasp" by Dr. W. B. R. Laidlaw (Edinburgh: John Baxter and Sons, Ltd. 3*s*.), the subject of the specific differentiation of the males in the genus *Vespa* is specially dealt with. The diagnostic characters concerned are illustrated by coloured and other plates together with tabular keys. The distribution of the genus in Scotland has also been specially studied by the author.

BOOTS' PURE DRUG CO., LTD., Nottingham, have recently issued a booklet with a useful thumb index, describing briefly their special medical products, with their modes of issue and prices. It is stated in the preface that all products must satisfactorily pass analytical tests and where necessary are examined bacteriologically and pharmacologically. Many of these special products are submitted to clinical trial before issue. The booklet has been specially compiled for the information of the medical profession.

THE National Botanic Gardens of South Africa has issued a seed list of seeds available from the plants grown in the Gardens at Kirstenbosch, Newlands, on the flank of Table Mountain. In addition to the African species grown here, there are also seeds of a certain number of exotic species of economic value, but perhaps even more interesting to British botanists will be the list of seeds available from the plants in the Karoo Garden, Whitehill. Applications for packets of seed have to be made to the Director at Kirstenbosch.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A chemist in the Admiralty Chemical Pool—Secretary of the Admiralty (C.E. Branch), London, S.W.1 (July 22).

A full-time graduate assistant master for electrical engineering and mathematics at the Paddington Technical Institute—Education Officer (T. 1), County Hall, London, S.E.1 (July 22).

A temporary lecturer in mathematics (woman) at Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks (July 24).

A lecturer in physics at Saint Luke's College, Exeter—The Principal (July 27).

An assistant with experience of the building industry at the Building Research Station, Garston, near Watford, Herts—The Director (July 27).

An assistant director and a secretary-statistician to the director of an industrial survey of South Wales—D. J. Davies, 1 St. Andrew's Place, Cardiff (July 29).

An assistant lecturer in metallurgy (founding) in the University of Sheffield—The Registrar (July 31).

A lecturer in the Department of Mechanical Engineering, Robert Gordon's Technical College, Aberdeen—Secretary (July 31).

Six gazetted civilian workshop officers for the Indian Army Service Corps (Mechanical Transport)—Secretary, Military Department, India Office, S.W.1, marked Mechanical Transport Recruitment (July 31).

A chemist in the Fulham Power Station—Town Clerk, Dept. 6, Town Hall, Fulham, S.W.6 (August 6).

Regius professor of zoology in the University of Glasgow—Private Secretary, Scottish Office, Whitehall, London, S.W.1.

A lecturer in physics and mathematics in the Rotherham College of Technology and Art—Director of Education, Education Offices, Rotherham.

Assistants for field and drawing-office work, Air Ministry—Secretary (W.B. 9, Room 161), Air Ministry, Adastral House, Kingsway, London, W.C.2 (by postcard).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 110.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Artificial Radioactivity of the Rare Earth Elements

WE have now completed a preliminary survey of the Fermi effect (radioactivity produced by bombardment with neutrons) with all the elements of the rare earth group except illinium (61) and thulium (69). The results are summarised in the table below.

Z	*Element*	*Isotopes*	*Half-life*	*Relative Intensity*	*Hydrogen Effect*	*Active Nucleus*
57	Lanthanum	139	$1{\cdot}9 \pm 0{\cdot}2$ days	0·5	12	La^{140}
58	Cerium	140, 142	no activity			
59	Praseodymium	141	$19 \pm 0{\cdot}5$ hours	0·9	—	Pr^{142}
60	Neodymium	142, 143, 144, 145, 146	no activity			
62	Samarium	144, 147, 148, 149, 150, 152, 154	*c.* 40 min. and a much longer period	0·03	—	? ?
63	Europium	151, 153	$9{\cdot}2 \pm 0{\cdot}1$ hours	19	40	Eu^{152} or Eu^{154}
64	Gadolinium	155, 156, 157, 158, 160	no activity			
65	Terbium	159	$3{\cdot}9 \pm 0{\cdot}1$ hours	0·6	—	Tb^{160}
66	Dysprosium	161, 162, 163, 164	$2{\cdot}5 \pm 0{\cdot}1$ hours	>30	20	Dy^{165}
67	Holmium	165	$2{\cdot}6 \pm 0{\cdot}2$ hours	>30	15	Ho^{166}
68	Erbium	166, 167, 168, 170	*c.* 7 min.	0·03	—	?
			$1{\cdot}6 \pm 0{\cdot}2$ days	0·3	—	?
70	Ytterbium	171, 172, 173, 174, 176	*c.* 3·5 hours	0·03	—	Lu^{176}
71	Lutecium	175	$4{\cdot}0 \pm 0{\cdot}1$ hours	1·0	—	Lu^{176}

The source of neutrons consisted of up to 400 millicuries of radon in contact with powdered beryllium, and the irradiation of the specimens was carried out in most cases in a large block of paraffin wax. The oxides of the rare earth elements were irradiated and measured as films containing about 0·3 grams/cm.^{2} and a similar film of silver oxide was irradiated at the same time. The relative intensities quoted in the fifth column of the table give a rough estimate of the activity per gram atom of the element when irradiated to saturation in the wax block in terms of the activity of the 2·33 min. period of silver irradiated under the same conditions. An entry "no activity" in the table indicates that the activity was less than 0·01 that of silver.

The most remarkable feature of the results is the intense activity produced by neutron bombardment of europium, dysprosium and holmium. These elements should prove useful as detectors of neutrons. The high activity shown by some of the rare earths makes it necessary, however, to take special care to ensure that weak activities ascribed to other rare earths are not due to the presence of a small amount of a highly active element. We have, therefore, examined in most cases specimens which on spectroscopic examination showed only traces of impurities, or specimens prepared in two different laboratories. In addition to those prepared by one of us (J. K. M.) we have used specimens of lanthana, praseodymia, neodymia and dysprosia, purchased from Messrs. Adam Hilger, Ltd., which on spectroscopic test are found to be free from other rare earths and contain only traces of other elements. We are indebted to Prof. G. Urbain for specimens of holmia, erbia and lutecia with which we have obtained the same results as with our own preparations.

We have confirmed the 19 hour period of praseodymium and the 40 minute period of samarium discovered by Fermi[1] and his co-workers but we have been unable to find an activity with an intensity greater than 0·01 on the silver scale for neodymium or for gadolinium, for which Fermi reports periods of 1 hour and 8 hours respectively. We are also unable to confirm the 5 minute period reported by these workers for praseodymium. On the other hand, we have found a considerable activity for lanthanum with a period of 2 days whilst Fermi reports that this element is inactive.

In an earlier letter[2] one of us (S. S.) reported periods of 2·9 hours for erbium and 2·5 hours for ytterbium, but the specimens examined were of doubtful purity. These results we now find are probably due to contamination with small amounts of holmium, as the purer specimens now studied give the periods quoted in the table. The erbia used in the later experiments was derived from a long series of fractionations as bromates and gave the same results as that supplied by Prof. Urbain. We have now examined a specimen of ytterbia separated from lutecia and other earths by the electrolytic method as insoluble $YbSO_4$. It gives a very feeble activity which is indistinguishable in period from that of lutecium and is probably due to residual traces of that element. The residual earths after the separation of ytterbium consisted chiefly of lutecia and gave a strong activity identical in period with that found for Prof. Urbain's specimen of lutecia.

The similarity in the periods found for the strong activities of holmium and dysprosium is somewhat curious. After the first observations had been made, the bromate fractions from which the specimens had been taken were submitted to another 1,000 crystallations and the specimens finally studied gave absorption spectra which showed that they were free from dysprosium and holmium respectively. Furthermore, specimens of dysprosia from Messrs. Hilger and of holmia from Prof. Urbain gave the same results as our own preparations.

It seemed possible that both elements might give rise to the same active product, namely, ${}_{66}Dy^{165}$ by the following nuclear reactions:

$$ {}_{66}Dy^{164} + {}_{0}n^{1} \rightarrow {}_{66}Dy^{165} \quad . \quad . \quad (1) $$
$$ {}_{67}Ho^{165} + {}_{0}n^{1} \rightarrow {}_{1}H^{1} + {}_{66}Dy^{165} \quad . \quad . \quad . \quad (2) $$

Nuclear processes of type (2) in which heavy particles are emitted usually show a hydrogen effect of unity. (Fermi, loc. cit.) We have, therefore, determined the hydrogen effect for both elements and find that it is large. Reaction (2) is therefore improbable and the

similarity in the periods of the products from holmium and dysprosium must be regarded as a coincidence.

We are indebted to Imperial Chemical Industries, Ltd., for a grant which has largely defrayed the cost of this investigation.

J. K. MARSH.

Old Chemistry Laboratory,
Oxford.

S. SUGDEN.

Birkbeck College,
Fetter Lane,
London, E.C.4.

[1] Amaldi, D'Agostino, Fermi, Pontecorvo Rasetti and Segrè, *Proc. Roy. Soc.*, A, 149, 522; 1935.
[2] Sugden, NATURE, 135, 469; 1935.

Artificial Radioactivity of Dysprosium and other Rare Earth Elements

IN their pioneer work on artificial radioactivity through neutron bombardment, Fermi and his collaborators announced the discovery of the activity of some of the rare earth elements, namely, of lanthanum, praseodymium, neodymium, samarium and gadolinium. Recently, Sugden[1] found that terbium shows an appreciable, and europium a very strong, radioactivity after bombardment with neutrons. We find that dysprosium shows an unusually strong activity due to $_{66}Dy^{165}$ under the action of slow neutrons; so far as we can ascertain, it is the strongest activity found hitherto. So little as 1/100 mgm. of dysprosium gives an easily detectable radioactivity after bombardment with neutrons from a source containing a few hundred millicuries of radium emanation.

As dysprosium is one of the most abundant yttrium earths, it will be present in detectable amounts in many preparations of such earths, and care must, therefore, be taken in interpreting the results of the activation of the elements of the yttrium group. One of the holmium preparations investigated was, however, found to be practically free from dysprosium, and decayed with a period of 35 hours. We find that erbium decays with a period of 12 hours, ytterbium was found to have a half-life value of 3·5 hours*, while lutecium decays much slower, having a period of about 5 days.

The periods and relative intensities of the rare earth elements 59–71 (praseodymium – lutecium) are seen from the following table, which also includes a

Element	Half-life	Relative Intensity	Half value thickness (in cm.)
59 Praseodymium	19 h[2]	4·5	0·045[2]
60 Neodymium	1 h[2]	0·04	
62 Samarium	40 m[2]	0 6	
63 Europium	9·2 h[1]	39	0 04
64 Gadolinium	8 h[2]	very low	
65 Terbium	3·9 h[1]	2·5	
66 Dysprosium	2·5 h	100	0·025
67 Holmium	35 h	20	0 04
68 Erbium	12 h	0·35	0·03
70 Ytterbium	3·5 h*	0·25	0·04
71 Lutecium	about 5 d	about 1	
47 Silver	2·3 m	8	0·03

comparison of the intensities obtained when the preparations were activated until the maximum activity under the action of neutrons slowed down through the presence of large blocks of paraffin wax. The table contains also the half-value thickness in aluminium of the β-rays emitted.

We find for the upper limit of the continuous β-spectrum of dysprosium an energy of $1·4 \times 10^6$ e.v. and for that of holmium $1·6 \times 10^6$ e.v. The activity of dysprosium obtained through the action of fast neutrons was only 1/100 of that measured in the presence of paraffin wax, Fermi's coefficient α being thus 100, while in the case of holmium we find $\alpha = 20$. The rare earth preparations investigated were given to us by the late Baron Auer von Welsbach.

G. HEVESY.
HILDE LEVI.

Institute of Theoretical Physics,
Copenhagen.
July 1.

* The weak activity observed is possibly partly due to the presence of traces of dysprosium; investigating a commercial preparation of ytterbia, Sugden (l c.) found a period of 2·9 hours.

[1] S. Sugden, NATURE, 135, 469; 1935.
[2] E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, A, 146, 483; 1934.

Enzyme Catalysis of the Exchange of Deuterium with Water

IN a further study of this reaction[1], we have found that the (first order) velocity constant depends markedly on the pressure of the hydrogen, being in fact inversely proportional to the square root of the pressure.

Sets of simultaneous measurements were made (at 37°) using equal samples of the same washed bacterial suspension (Bact. Acidi Lactici) so that all conditions could be made identical except the pressure.

The results of two typical sets are shown in Fig. 1, where the logarithm of the final deuterium concentration in the gas (C) is plotted against $p^{-1/2}$, that of the initial concentration (C_0, common to the set) being plotted on the axis ($p^{-1/2} = 0$).

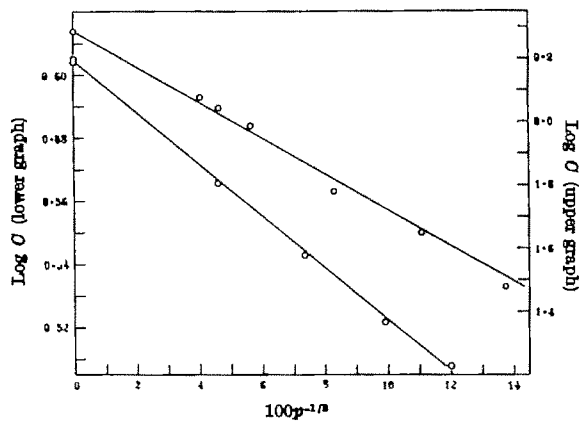


Fig. 1.

In these two sets, the number of bacteria present happened to be practically the same (8×10^{11}) but the times of reaction (t) were respectively 1212 min. (upper set) and 180 min. (lower set). The graphs, therefore, correspond to the equation

$$\log C_0 - \log C = Ktp^{-1/2} \qquad (1)$$

where K has the values 0·0047 and 0·00453 respectively.

It was found in all cases that, during the course of the reaction, the number of living bacteria, as

shown by the viable count, was diminishing rapidly (half-life period two to three hours), but this does not appear to affect the catalytic power. In fact, experiments made with the same suspensions after these had been kept for six days yielded practically the same value for the velocity constant.

A similar lack of correlation between enzyme activity and viability has been observed in the case of oxidative mechanisms[2].

From equation (1) we conclude that, as in the analogous case of metallic catalysts for which the same dependence on pressure has been established[3], the reaction takes place in two stages:

$$HD + 2B \rightleftharpoons HB + DB,$$
$$DB + H_2O \rightarrow HB + DHO,$$

(where B represents a catalytic 'centre') of which the second is much the slower and, therefore, the rate-determining stage.

We are attempting to estimate the rate of the first stage reaction also, by the use of parahydrogen and the $D_2 + H_2 \rightarrow 2HD$ reaction.

G. H. BOTTOMLEY.
B. CAVANAGH.
M. POLANYI.

University of Manchester.
June 19.

[1] Observed independently by Farkas, Farkas and Yudkin, *Proc. Roy. Soc.*, B, 115, 373; and by Cavanagh, Horiuti and Polanyi, NATURE, 133, 797; 1934.
[2] M. Stephenson, *Ann. Rev. Biochem.*, 2, 488; 1933.
[3] Horiuti and Polanyi, *Proc. Manchester Lit. and Phil. Soc.*, 78, 50; 1934.

Precision of Line Standards

DR. W. EWART WILLIAMS has recently published in NATURE[1] an interesting article on "Light-Waves as Units of Length". In a memorandum entitled "Les idées actuelles sur la définition de l'unité de longueur"[2], which appeared in 1927 (and which I admit is now somewhat out of date), I discussed this question in detail, and the conclusion at which I arrived was on the whole but little different from that of Dr. Williams. There is, however, one point which I should like to touch upon again in reply to the doubt expressed by him regarding the accuracy of $0 \cdot 2\,\mu$ attainable with line standards.

The doubt stated by Dr. Williams is based principally on the evident impossibility of defining to a precision of $\pm\, 0 \cdot 03$ mm. the centre of a fiduciary line magnified 300 times, such as shown in the photograph illustrating his article, and he adds that the uncontrolled variations in the conditions of illumination necessarily involve greater errors than indicated above.

In considering the reading of a single fiduciary line, I would in the first place point out that the reproduction in NATURE by no means represents the appearance of a line as seen through the microscope of a comparator. The photograph was taken at a frontal distance of about one millimetre. The illumination was by means of a prism and therefore strongly tilted in the direction of the line, which exaggerates its defects. In the second place, it is not the centre of the line that is read, but its axis, viewed by symmetrical setting between the two threads of the micrometer situated on either side. The evaluation of the two boundaries of the line, in conformity with the definition recently laid down in detail for line standards, is much more precise than the reading of the centre. Finally, as to the effect of the lateral inclination of the light beams, the experiments of MM. Volet and Bonhoure[3], in which the source of light is moved systematically to the utmost extent first to the right and then to the left of the same line, have not occasioned apparent displacements greater than $0 \cdot 6\,\mu$. The possible uncertainty due to a faulty adjustment of the illumination cannot therefore exceed a very small part of this maximum. I would add that the line reproduced in the illustration is the worst line, given by way of example, of the worst of our old prototypes, bar 26, which has been in constant use for forty-six years. The addition several years ago of a more recent prototype to the working standards of the International Bureau has prepared the way for its withdrawal.

It must not be forgotten, however, that the reading of a line viewed separately has no significance whatever. Each bar has two similar lines, traced consecutively by the same tool on surfaces polished in the same way and cut in the same manner. Must not any systematic error in the viewing of lines be eliminated for a double reason? The two lines are seen under microscopes similar in all particulars; and the bar is intended to serve only in comparison with another bar read by the same observer under the same microscopes provided with the same illumination.

Moreover, the evaluation of a bar is not determined by one reading of the lines in a single position of the bar. A series of comparisons with another bar includes twelve observations, six on each bar in turn, each observation being the mean of two readings. Eight series are executed, including every symmetrical position of the bar with regard to the comparator and consequently to the illumination (which remains fixed) and to the observer. For all major comparisons, many other checks are taken advantage of by comparisons with other bars which are taken in groups of five or six, in all possible combinations two by two, so that finally the value attributed to a bar is the result of not less than five hundred readings of each of its lines. Those who are prepared to accept the result of the calculation of probabilities applied to metrology may deduce therefrom that it is sufficient to make each duplicate reading of a bar with a precision twenty times less, that is, about $4\,\mu$ for a double reading of the bar itself, or, if one makes use of a magnification of 300, then something less than a millimetre. Even by making use of the photograph reproduced in the article, similar reasoning (in which, however, I have little confidence) would lead to a higher degree of accuracy than $0 \cdot 2\,\mu$ for the evaluation of a line standard.

It is always interesting to seek for explanations of facts and I have not failed to do so. But the true answer to the doubt expressed by Dr. Williams is the direct affirmation of experience. It is found in practice that a line-bar of good quality compared with a group of others reproduces the same value, whatever may be the experimental conditions and whoever may be the observer, with a precision of $\pm\, 0 \cdot 2\,\mu$. This evaluation of accuracy is that of the strictest metrologists, among whom I number myself. There are metrologists, not without distinction, who would accept a still more favourable evaluation[4].

It remains now to explain the discrepancy pointed out by Dr. Williams, of 0·0036 A. between the value of the cadmium red wave-length as determined by the Reichsanstalt and by the National Physical Laboratory. If as he thinks probable, this

difference arises from the initial comparison of the national prototypes with the Sèvres working standards, it would correspond to an error of 0·56 μ between the British and German prototypes. But this supposition has recently been shown to be unfounded. The prototype No. 16 of Great Britain and No. 18 of Germany have since been returned to Sèvres, and with the obliging collaboration of a metrologist from the N.P.L., have been very carefully compared one with the other. The result showed, within about 0·06 μ, the same difference that we attributed to them previously.

ALBERT PÉRARD.

Sèvres.
May 24.

[1] NATURE, 135, 459 and 496; 1935.
[2] "La Création du Bureau international des Poids et Mesures et son Œuvre". Paris: Gauthier-Villars, 1927, p. 259.
[3] "Procès-Verbaux des séances du Comité international des Poids et Mesures", Deux. série, 15, 30; 1933.
[4] See Ch.-Ed. Guillaume, "Les Récents Progrès du Système métrique", pp. 14 and 15; 1934.

M. PÉRARD's justification of the metrologist's claim of being able to compare two line standards with an error not exceeding ± 0·2 μ is based entirely on the degree of concordance observed in practice when large numbers of readings are taken in all possible positions. Equally so, we find when we analyse the purely interferometric data for the number of waves contained in an optical gauge of a metre length, the concordance between the individual results is even more striking.

Michelson has expressed the opinion[1] that if the standard metre had been an optical gauge instead of a line standard, the accuracy of the wave-length determination could be increased five-fold. Sears and Barrell[2] estimate that the overall probable error associated with the optical measurement is ± 0·016 μ, while the average accuracy of repetition in the measurement of line standards is taken to be of the order of ± 0·25 μ.

Unless the difference between the values of Kösters and of Sears and Barrell can be ascribed to uncertainties regarding the lengths of the line standards, one is driven to the conclusion that the discrepancy is due to a lack of symmetry in the hyperfine structure of the red cadmium source. With such asymmetry, the value obtained for the wave-length is an oscillating function of the path difference in the interferometer. This effect is much more pronounced with the Michelson instrument, or the Twyman and Green modification of it as used by Kösters, than with the Fabry-Perot interferometer employed by Sears and Barrell. The higher the effective number of reflections, the more closely does the interference fringe correspond to the real intensity distribution of the spectral line itself. Sears and Barrell used plate separations of 1/12th and 1/9th metre as basic units and were not able to detect a measurable difference in the wave-length value.

Hence, in spite of M. Pérard's assurances, there still remains the possibility that the experimental error in line standard comparisons may in reality be two or three times larger than his estimate.

W. EWART WILLIAMS.

King's College,
Strand, W.C.2.
June 18.

[1] "Studies in Optics," p. 54.
[2] *Phil. Trans.*, 233, 173; 1934.

Origin of Tektites

GLASSY particles weighing between approximately a gram and occasionally a hundred grams have been found at several widely separated places on the earth's surface. The explanation of the origin of these natural glass particles, known as tektites, is complicated by the series of peculiar forms which they exhibit and the size of the areas over which they are found. They have been collected from each of the States in Australia, and because of this continental distribution are frequently called Australites. Several theories of their origin have been advanced and discussed in NATURE, vols. 131 and 132, 1933. Dr. L. J. Spencer and others suggest that the tektites are 'aerial fulgurites', the post-impact result of a great meteorite striking the earth in a region of sandstone or desert sand. Comparison is made with the silica-glass from the meteor craters at Henbury and Wabar. The main difficulty in accepting their theory is the wide distribution of the particles wherever they are found. The W. H. C. Shaw collection of Australites was made over a region of 30,000 square miles on a "monotonous limestone plain" on the southern shore of Australia[1]. Furthermore, Fenner points out that the region is "without any siliceous rocks whatever"; hence a fulguritic origin for these Australites appears to be impossible.

Another theory assumes that they were originally extra-terrestrial bodies and that at the time of a meteoritic passage through the earth's atmosphere they became liquid from the frictional heat (Michel, Suess, and others)*. As they cooled, the combination of air resistance and some rotational motion of their own caused them to take on the lens, tear-drop, or dumbbell shapes which are observed[2]. There are several theoretical difficulties with the possibility of such a shaping process, as well as the observational objections discussed below.

There are numerous bodies which are known to have descended through our atmosphere from interplanetary space. These objects comprise three classes of meteorites: stones, stony-irons and irons. The irons show a peculiar crystalline structure, known as the 'Widmanstätten figures', which disappears when heated above 850° C. The presence of these figures to within a few millimetres of the surface of the iron meteorites indicates that they were not heated to this temperature during their brief meteoric flight. The stones also show no internal indications of having been heated to this temperature. Further, the melting point of Darwin glass, a form of tektite, is about 1,400° C.[3]; it is composed very largely of silicon dioxide (about 87 per cent SiO_2) and its coefficient of thermal conductivity is about 0·002 cal. per cm. degree sec. (fused silica, glass and sandstone). The coefficient of thermal conductivity for iron is about 0·10 in the same units. Hence we see that a lower temperature is required to affect the iron meteorites than to melt the tektite, and that the rate of heat transfer is about fifty times greater for the iron meteorite than for the tektite; yet the iron meteorites give no evidence of having been heated to an internal temperature† of 850° C. It therefore

* The combustion theory of Lacroix appears artificial; the reaction suggested probably could not occur during a meteoric flight, as the meteoric phenomenon is now interpreted.

† A low internal temperature for iron meteorites in flight through the atmosphere is assumed as the result of the 'ablation' (liquification and immediate removal) of the heated surface. This process is generally believed to absorb most of the heat of the atmospheric resistance[4], freshly fallen meteorites are seldom described as being more than "milk warm".

appears impossible that sufficient heat from atmospheric friction was transferred to the interior of the tektites to allow them to melt and take on the observed shapes.

For the reasons given above we consider that, as yet, no satisfactory meteoritic theory has been advanced to explain the origin of tektites.

FLETCHER WATSON, JR.

Harvard College Observatory,
Cambridge, Massachusetts.
June 10.

[1] C. Fenner, "Australites", Part 1. "Classification of the W. H. C. Shaw Collection", *Trans. Roy. Soc. South Australia*, **58**, 63 and 64; 1934.
[2] A. Lacroix, "Les Tectites de L'Indochine", Extract of the *Arch. Muséum National d'Histoire Naturelle*, 6ème Ser., **8**; 1932. C. Fenner, *op. cit.*, pp. 62-79.
[3] A. Lacroix, *op. cit.*, p. 211.
[4] W. J. Fisher, Harvard College Observatory Circular, 385, 1934.

Philosophy and Modern Science

I AM sorry if my psychological knowledge fails to reach the standard required by Dr. Dawes Hicks[1]. My book[2] has, as a matter of fact, been the subject of favourable notice in three psychological journals, though I cannot claim the universal agreement that would apparently be necessary to make it convincing to Dr. Dingle. I have done my best to explain what I mean by the terms used.

What Dr. Dawes Hicks calls a 'sensum' seems to be what Russell called a 'sense-datum'; and I do not use sense-data, partly because most of the alleged existing sense-data are not perceived and therefore are not part of our fundamental knowledge, and partly because some inference and refinement are necessary before we can pass from our immediate knowledge to even the perceived sense-data. I am not sure whether I accept Dr. Hicks's other definition; his words 'mental act' seem to presuppose that we know what we mean by mind and that there is some kind of activity in merely having a sensation; the former seems to me to be posterior, not anterior, to sensation, and the latter is I think untrue. When my eyes are open I am aware of various patches of different shapes and colours, which disappear when my eyes are closed. Those are what I mean by a sensation. They seem to be immediate and not the result of any activity on my part; they just happen. In the case of sensations of sound even the minor preliminary activity of opening my eyes is unnecessary.

Again, Dr. Hicks's definition of a concept presupposes the existence of universals, and apparently denies the existence of different degrees of universality. Here I definitely disagree. A single observation of Neptune is merely a bright spot surrounded by blackness, with appropriate modification in the case of a photographic observation. It is only when many observations are available that we can form the idea of a single body moving in a definite way; generalisation has already been applied in thinking of Neptune at all. The individuals are merely a certain finite number of bright spots.

I am quite clear that I do not experience another person's sensations. He can tell me about them, and I may believe what he says; but a long process of inference has been involved before I can attach a meaning to this statement and put them on a similar footing to my own. It is well known to astronomers that the observations of different observers need certain corrections before they become comparable among themselves.

I agree with Dr. Campbell's second paragraph; I should also agree with his first if I was sure that he does not regard my view as a philosophy. I regard it as a description of the method of acquirement of knowledge. For example, what I call a concept is substantially what Pearson called a construct; but I prefer not to use the latter term because it suggests acceptance of the phenomenalist philosophy, while I think that there is nothing in my work that could not be equally well accepted by a critical realist.

Though I do not necessarily agree with Prof. Levy entirely, I consider him clearly right in objecting to Prof. Dingle's adoption of universal agreement as a fundamental criterion while trying to maintain a critical attitude about the reality of the external world, since other people are part of that world. My own opinion is that both are inferred from much more fundamental data.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

[1] NATURE, **135**, 1035, June 22, 1935.
[2] "Scientific Inference", 1931.

DR. NORMAN CAMPBELL is so far right that in the philosophical interpretation of science conceptions about reality and existence lie at the very core of the matter. To me, these are primaries and indefinables. They can be explained only in terms of human practice; that is to say, again only in terms of the active side of reality and existence. The 'logical network' view cannot embody in its scheme this activist side of reality, for it is basically static and contemplative in character and purpose. A social philosophy of science, on the other hand, automatically makes man's capacity for changing the world an integral part of its story. The purpose of the philosophy is both conscious and dynamic.

It is for this reason that Mr. C. O. Bartrum[1] misses the point when he argues that the difference between the two views is merely one of words. The extent to which words may indeed arouse confusion is apparent when Mr. Bartrum quotes me as saying "that the man of science should be responsible for the social consequences of his work" and when he pictures the terrifying results that would follow in every laboratory if this were accepted. What I actually wrote was that my view keeps "the scientist alive to the social consequences". There is an ocean of difference between the two statements.

H. LEVY.

Imperial College of Science,
South Kensington, S.W.7.

NATURE, **135**, 1036, June 22, 1935.

Origin of Man Again?

THE controversy on "Special Creation and Evolution"[1] continues to recur periodically in spite of the fact that it has long been known to scholars and learned Kabbalists that the Biblical narrative of *Genesis* is a representation of Chaldean allegories. To-day in many branches of science, writers can expound their knowledge for the uninitiated only by means of similes, metaphors and analogies; and yet it is still the practice to translate and interpret

ancient writings and glyphs literally and in terms of our present-day ideas, hypotheses and preconceptions.

Tentative theories and schools of thought are multiplying owing to the complexities revealed in recent years by researches in all departments. In a valuable summary of current opinions on the origin of species[2], Prof. J. Ritchie referred to "the minimum that different types of mind are prepared to allow in order to bridge the gulf of scientific analysis". It is evident that the synthetic function of the mind will not give birth to a new synthetic generalisation just yet; but the wider the search for an embryonic hypothesis the sooner will one be found that is workable and acceptable to the majority.

Evolution is a fundamental cosmic principle in all ancient philosophies; but it is conceived as a *dual process of involution and evolution operating in spiral cycles*. The creative energies of Nature are *serial emanations* or 'rays' symbolised by numbers, glyphs and geometrical ideographs. While the explanation of the evolution of species (*cf.* the *Purānas* and *Vedas*) is similar to the Darwinian theory of Western science, that given for the origin of man is different.

In "The Descent of Man"[3] there is a passage on hermaphrodite forms which shows how near Darwin came to postulating a primeval androgynous stem from which, according to ancient teachings, the mammals sprang.

Briefly, in the Eastern Aryan philosophy:

(1) Each *genus* has its own 'primordial' and distinctive 'form'; and these ethereal prototypes are gradually precipitated contemporaneously with the condensation of the globe.

(2) They had become semi-physical colloidal forms of bi-sexual animals in the early Secondary Age, and were fully consolidated physiologically, and sexually differentiated during the Jurassic period. Man preceded most of the mammals.

(3) The evolution of species, races and variations was subsequent to the complete physicalisation of the tenuous colloidal forms.

This 'hypothesis', of course, "simply pushes the problem back to"—another *state*! But the phenomena of 'periodical precipitation' and of colloidal states had not been investigated in Darwin's time. To-day we are accustomed to seek for 'causes' and 'origins' in imperceptible states.

W. W. L.

[1] NATURE, 135, 987, June 15, 1935.
[2] NATURE, 132, 506, Sept. 30, 1933
[3] "The Descent of Man", second edition, p. 161.

Alchemy and Music

THE supposed connexion between alchemy and music is much older than the sources quoted by Prof. Read[1]. A treatise in the "Collection" of Greek alchemists[2] deals obscurely with this subject, and it has been the object of an interesting study by Prof. Stephanides, of Athens[3]. The ultimate source is, of course, the "Timaeus" of Plato, in which the compositions of materials are explained as due to mysterious 'harmonies'. Plato was in later life much influenced by Pythagorean schools, as has been shown by Frank[4]. He was obsessed by the idea that mathematics is in some way or other the ultimate reality, and that Nature must be explained by mathematical laws, or even Nature *is* these mathematical laws. In this he seems surprisingly 'modern', or rather, modern views seem surprisingly Platonic. Most of the ideas of later alchemy are merely more or less denatured versions of the theories of the Greek alchemists, and if the music was intended for performance during the practical operations this may also be an old ritual.

J. R. PARTINGTON.

Wembley.

[1] NATURE, 135, 967; 1935.
[2] Berthelot, "Collection des Alchimistes Grecs", 2, 421.
[3] Μουσική καὶ Χρυσοποιία, in Ἐπετηρὶς τῆς ἑταιρείας τῶν Βυζαντινῶν σπουδῶν, 4, 39–45 (Athens, 1927). Hammer-Jensen, "Die älteste Alchymie", *Kgl. Danske Vidensk. Selskab., Hist.-filol. Meddel.*, 4, 11, 144 (1921)—'sie ist von Interesse hinsichtlich der byzantinischen Kirchenmusik'.
[4] "Plato und die sogenannten Pythagoreer", Halle, 1923.

THE lecture concerned dealt exclusively with certain aspects of seventeenth century alchemy, and Maier's musical compositions of 1618 may perhaps be taken as the last and most definite attempt to associate alchemy with music. Prof. Partington's early references are very interesting.

JOHN READ.

St. Andrews.

Breeding of *Loris* in Captivity

THERE is no record of *Loris* having been bred in captivity, so it seems worth recording that one was born in my collection recently.

This animal is well known to be difficult to keep alive in confinement, and in the hands of most persons who have kept them they live only two to three months. As the period of gestation appears to be longer than this, it is not surprising that breeding has not occurred, though several instances have been recorded[1] of babies having been born to females already pregnant at the time of their capture.

Upwards of fifty individuals of the genus have now passed through my hands, and I have been successful in keeping them alive in confinement for varying periods. Some still alive have been in captivity for more than two years. The Mysore loris (*L. tardigradus lydekkerianus*) appears to stand confinement better than the Ceylonese races.

In April 1934, on leaving Ceylon on furlough, I left my collection in the charge of Dr. L. Nicholls, Government bacteriologist. In one cage were a number of specimens of the loris *L. t. tardigradus*, and in the same month was added a full-grown male of the northern race, *L. t. nordicus*. I noticed that, at the time of handing over, all the males had their testes fully descended, whereas previously their scrota had been empty. The descent in some of the males took place over-night.

All the lowland lorises in the cage mentioned died in my absence, except one female. She was evidently impregnated by the northern male in the latter part of 1934. Dr. Nicholls informs me that no copulation was observed. A baby was born on April 24, 1935. I noticed a few days later that the father had his testes descended again

It seems out of the question for the pregnancy to have occurred as a result of the rutting activities of the male in April 1934, as this would give a pregnancy of nearly a year. It seems much more likely that the male has a testicular descent twice a year as suggested by Narayan Rao[2], and that the pregnancy dated from a rutting season in or about September or October 1934.

Although the full evidence cannot be discussed here, it would seem that *Loris* in its breeding habits

differs from its nearest relative, *Nycticebus*, and also from *Tarsius*, both of which breed continuously, and agrees with *Lemur* in having a well-demarcated bi-annual breeding season[3]. It would also appear that the gestation period is somewhere in the neighbourhood of six months—a very long period for so small an animal. This time, however, is supported by the evidence of a very long lactation period as already reported by me[4].

W. C. O. HILL.

Anatomy Department,
Medical College,
Colombo.
May 28.

[1] Pearless, S. H., *Spolia Zeylanica*, 6, 134; 1909.
[2] Narayan Rao, C. R., *J. Bombay Nat. Hist. Soc.*, 33, 206–209; 1937.
[3] Zuckerman, S., *Proc. Zoo. Soc.*, 1059–1075; 1933.
[4] Hill, W. C. O., *Ceylon J. Sci.*, B, 18, 89–132; 1933.

Chemistry of Œstrogenetic Substances

As reported previously, unsaturated fat-aromatic α-ketonic acids injected into spayed mice give rise to the appearance of cornified cells in the vaginal smears[1]. Contrary to these results, J. W. Cook and E. C. Dodds failed to see an œstrogenetic effect with benzal-pyruvic acid and fural-pyruvic acid on spayed rats[2].

The total doses required for spayed mice are 24 mgm. dry sodium salts given in three doses at intervals of 24 hours. Cook and Dodds, working on rats, used doses of 100 mgm. (Calculated according to Parkes and Dodds[3], 240 mgm. would be the corresponding doses to produce œstrus in rats.) Their doses, therefore, were insufficient. Furthermore, they space the single injections of these substances in such a way that even a total amount, otherwise active, would be inactive under these conditions. "The importance of spacing the injections at the correct intervals cannot be over-emphasised." (Cook, Dodds *et al.*)[4]

The œstrogenetic effect of benzal-pyruvic acid and fural-pyruvic acid on spayed mice has been observed independently elsewhere. The statement that the œstrogenetic activity of unsaturated fat-aromatic α-ketonic acids is of the order of 1-keto-1.2.3.4.-tetrahydrophenanthrene is correct. It is known that figures of the same order are not necessarily identical figures.

E. FRIEDMANN.

Sir William Dunn Institute of Biochemistry,
University, Cambridge.
June 12.

[1] E. Friedmann, NATURE, 135, 622; 1935.
[2] J. W. Cook, E. C. Dodds, NATURE, 135, 959; 1935
[3] A. S. Parkes, E. C. Dodds, quoted from E. C. Dodds, *Lancet*, 1, 935; 1934.
[4] J. W. Cook, E. C. Dodds, C. L. Hewett, W. Lawson, *Proc. Roy. Soc.*, *B*, 114, 280, 1933

Carotid Gland of the South African Bullfrog

THE physiological and histological studies of Heymans[1], de Castro[2], Koch[3] and others have clearly shown the great importance of the sinus caroticus in the control of circulation and respiration in mammals. The carotid nerve, which arborises in the adventitia of the sinus, is innervated by the internal pressure of the blood, and the heart-rate and respiration are reflexively affected.

Except perhaps for its absence in a few species, for example, *Ichthyophis*, the carotid gland is very characteristic of amphibians.[4] It is also present in *Breviceps*, which never takes to water. It may therefore be profitable to study it in the light of the works on the carotid sinus in mammals.

The carotid gland of a full-grown *Pyxicephalus adspersus* is approximately 2·5 mm. in length and 1·5 mm. in breadth. Its size allows of macroscopic dissection, while on the other hand it is small enough to be fixed entire for histological dissection and staining. A series of longitudinal sections supplemented by a series of transverse sections show the following: Soon after its entrance into the swelling, the common carotid artery is seen to communicate by means of several openings with two fairly large vessels, which join and leave as the external carotid artery. The openings may also be seen in a longitudinal macroscopic dissection of the 'gland'. Somewhat deeper in the swelling, the lumen of the common carotid expands, but eventually breaks up into a network of arterioles. These again unite to form a flattened lumen, which, however, becomes more arterial and leaves as the internal carotid artery.

Several interesting points may be noted. Melanophores occur abundantly in the network, while groups of cells are distributed in it which are very reminiscent of nerve cell bodies. Silver staining will be resorted to in order to detect nerve fibres if present. Histologically the carotid gland is a very much elaborated artery. Compared with that of the sinus caroticus in mammals, its media is very thick and traversed by many elastic fibres. The carotid gland will therefore not allow of passive dilation to the extent that the sinus caroticus does. Constriction of the carotid glands in the etherised frog registered no notable change in the frequency of the heart-beat.

Suggestions as to the probable function of the carotid glands in the frog are reserved at this stage of the study.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
June 6.

[1] Heymans, Bouckaert and Regniers, "Le Sinus Carotidien", Paris, 1933.
[2] De Castro, *Trav. Lab. Rech. Biol.*, 1928.
[3] Koch, "Die reflektorische Selbsteuerung des Kreislaufes", Dresden and Leipzig, 1931.

Forces of Attraction of Homologous Loci and Chromosome Conjugation

A SERIES of genetic and cytological data show that chromosome conjugation at meiosis is caused by the attraction of homologous parts.

A study of chromosome behaviour in heterozygous inversions has disclosed with special clearness the action of these forces. We have obtained a stock of *Drosophila melanogaster* possessing attached *X*-chromosomes, one of which had an inversion involving almost the whole chromosome. If the forces of attraction of homologous loci are sufficiently great to overcome conjugational difficulties, which are connected with heterozygous inversions, chromosome conjugation ought to take place as in Fig. 1 (left hand). In this case ring chromosomes would form as a result of a single crossing-over in an inverted region. On the left end of the *X*-chromosome, these ring chromosomes would have a small deficiency and on the right one a duplication. The stock with

attached X-chromosomes obtained by us gave a progeny, part of which in fact contained a ring chromosome (Fig. 1 (right hand), Stern's culture $xy'\ y^{w}$).

The frequency of single crossing-over (number of distal recombinations) had at the same time not decreased. Here, too, in all the one hundred per cent of ovocytes, the same as under normal conditions, the X-chromosome undergoes crossing-over and forms at least one chiasma.

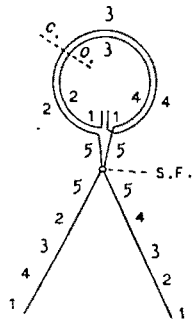


FIG. 1.

A study of double crossing-over in a similar heterozygous inversion sc^{8} (non-attached X-chromosomes) has shown that the difference between the frequency of double cross-overs in a heterozygous inversion sc^{8} and that of double crossing-over in a homozygous one, may be explained by the occurrence of new regional differences during ring conjugation. The increased percentage of non-disjunctional males and females which arise in a heterozygous inversion are a result of double crossing-over. Experiments show that the increase of double crossing-over in a heterozygous inversion causes an increase of the number of exceptional individuals. The presence of the latter cannot therefore prove the disturbance of chromosome conjugation.

The data obtained by us in this work indicate that in a heterozygous inversion of *Drosophila*, chromosome conjugation occurs in the same way as has been described by McClintock for *Zea Mays*. There the forces of attraction of homologous loci which bend the chromosome into a ring cause complete conjugation, notwithstanding the presence of an inversion in one of the chromosomes.

The existence of a *Drosophila* stock with attached X-chromosomes where ring chromosomes are permanently formed, is a new cytogenetic proof of Morgan's theory of crossing-over.

B. N. SIDOROV.
N. N. SOKOLOV.
I. E. TROFIMOV.

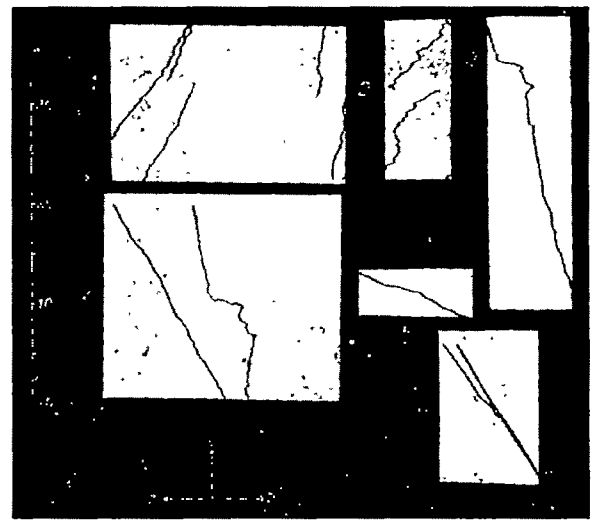
Department of Genetics,
Institute of Experimental Biology,
Moscow.
May 7.

Cosmic Ray Bursts in Liquid Dielectrics

BURSTS of ionisation produced by cosmic rays have been studied up to now in large ionisation chambers filled with a gas at high pressure. We found it advantageous to use for this purpose ionisation chambers filled with a very carefully purified liquid dielectric.

A series of preliminary observations was made with the use of a cylindrical condenser having a capacity of nearly 1 litre containing hexane (C_6H_{14}); the interior armature was an empty cylindrical vessel. The conductivity of the hexane was as low as $2 \cdot 3 \times 10^{-19}\ \Omega^{-1}$ cm.$^{-1}$. In most cases a difference of potential of 1,800 volts was applied; such a considerable field was necessary in view of the small mobility of ions in a dielectric liquid (mean value in hexane[1] is 5×10^{-4} cm./sec. per cm./volt).

The armature receiving the charge was connected with a quadrant electrometer of common pattern. It recorded the gradual charging of the system by the spontaneous current in the liquid. Bronson resistance was used for compensating this current. Bursts provoked sudden deviations of the electrometer needle and corresponding displacements on the curve of the record. It was possible easily to recognise bursts supplying more than 3×10^{6} ions (the actual number of ions produced was considerably greater in consequence of the loss by recombination).



To characterise the phenomenon we give two numerical results and reproductions of some records obtained[2]. In an unprotected ionisation chamber, the number of bursts was 2 in 11·7 hours. In the most favourable case, the chamber surrounded by lead blocks 5 cm. thick and the aluminium cylinder put into the interior armature, the number of bursts increased to 37 in 13 hours.

In the accompanying illustration are reproduced the records of some typical bursts: Nos. 1, 2, 3 are simple bursts; Nos. 4, 5 seem to be double bursts; No. 6 is of more complicated structure. The arrows indicate directions of deviations of the electrometer needle due to (*a*) compensating currents, (*b*) residual, and (*c*) the direction of movement of the sensitive film. On the left is a time-scale in minutes, which enables a rough estimate to be made of the duration of the bursts.

C. BIAŁOBRZESKI.
I. ADAMCZEWSKI.

Institute of Theoretical Physics,
Warsaw.
May 28.

[1] One of us has recently made a detailed study of the mobility of ions in liquid paraffins: I. Adamczewski, *Bull. Int. Acad. Polonaise*, 217; 1934. The existence in these liquids of three sorts of ions of different mobilities was discovered.

[2] More details will be given in a paper appearing in a forthcoming issue of *Bull. Int. Acad. Polonaise*.

Electrical Units and the I.E.C.

PROF. E. W. MARCHANT, who was one of the British representatives at the recent meeting of the I.E.C. at Brussels, has sent me an account of the proceedings in connexion with the proposed introduction of the M.K.S. system, which he authorises me to publish. I should be greatly obliged if space could be found for it in NATURE.

R. T. GLAZEBROOK.

Laboratories of Applied Electricity,
University of Liverpool.
July 9, 1935.

DEAR SIR RICHARD GLAZEBROOK,

Dr. Rayner has written to me regarding the meetings of the E.M.M.U. at Scheveningen. It was agreed that the M.K.S. system should have units which were consistent with the C.G.S. system, and all the representatives of the different countries agreed that it was very desirable that the present practical system should be extended so as to make it a coherent system of units. When the matter came up for discussion at the Committee of E.M.M.U., the question under discussion was divided into two. The first was concerned solely with the desirability of a coherent M.K.S. system without specifying the fourth unit, and the second with the choice of the fourth fundamental unit. On the first question, all the members declared themselves in favour of the adoption of an M.K.S. system with four fundamental units, except the representative of Norway, who abstained. On the second question, the Committee decided to consult, on one hand the Consultative Committee of the B.I.P.M., and on the other hand, the S.U.N. Dr. Lombardi was asked to prepare the question to submit to the Consultative Committee of the B.I.P.M., and Dr. Kennelly to prepare that to be submitted to the S.U.N. Although there is nothing in the minutes of the proceedings stating that the basis of the decision regarding the fourth unit should be that the permeability of free space should be taken as unity, that point was repeatedly raised in the discussion, and the way in which the matter was left, was that the committees to be consulted should be asked to give a value for the fourth unit which was consistent with the value of the permeability of free space being equal to unity.

It was agreed by everyone that the fourth unit to be adopted (either a unit of quantity of electricity or a unit of resistance) must be consistent with the C.G.S. system of units, and the reason why the question of the fourth unit was referred to the two committees concerned, was that the Commission was anxious that whatever unit was chosen should be consistent with the C.G.S. system of units.

Yours very truly,

E. W. MARCHANT.

Points from Foregoing Letters

DR. J. K. MARSH and Prof. S. Sugden describe and tabulate results obtained by bombarding rare earth elements with neutrons. Radioactivity of varying intensities, with half-life from a few minutes to two days, was produced in nine out of thirteen elements. Europium, dysprosium and holmium were found particularly active; it is suggested that these elements may be useful as neutron detectors. Prof. G. Hevesy and Miss Hilde Levi give a similar table for the radioactivity induced in eleven rare earth elements. The two tables are not in entire agreement, owing, as both groups of investigators point out, to the difficulty of obtaining the rare earths in a pure state. Neodymium and gadolinium, the activity of which is given as zero by Marsh and Sugden, are said, by Hevesy and Levi, to have a slight activity; the values for the intensity and half-life in the case of several other elements also differ in the two tables.

The rate at which molecules of heavy hydrogen gas are exchanged for the hydrogen atoms of water molecules in a suspension containing lactic acid bacteria varies with pressure, the velocity constant being inversely proportional to the square root of the pressure, according to Messrs. G. H. Bottomley, B. Cavanagh and M. Polanyi. The active catalytic agent is an enzyme equally active whether the bacteria are dead or alive.

M. A. Pérard describes the methods employed in determining the length of the national prototypes of the standard metre, and concludes that in spite of the raggedness of one of the fiduciary lines, an accuracy of 0·2 microns is possible. Dr. W. E. Williams emphasises the fact that accuracy would be greater if an optical gauge were used in place of the line standard. He still believes it possible that a discrepancy of 0·56 microns in the length of the British and German standards may exist.

F. Watson, Jr., reviews critically theories dealing with the origin of tektites, which are small glassy particles of lens-like, pear or dumb-bell shape, found at various places on the earth's surface. He concludes that no satisfactory meteoric theory of their origin is as yet available.

Prof. W. C. O. Hill records that a specimen of loris, one of the Indo-Malayan lemurs, was born in captivity in Colombo, and describes the breeding habits and period of gestation of the species.

A histological study of the carotid swelling in the South African bullfrog, *Pyxicephalus adspersus*, by Dr. G. Eloff, has shown that it is a much elaborated artery with a relatively thick media. Before the internal carotid artery leaves the swelling, the common carotid breaks up into a *rete mirabile*, in which melanophores occur abundantly, and probably also nerve-cells. Constriction of the carotid swellings did not affect the heart-rate.

The formation of a loop during the conjugation of heterozygous chromosomes (derived from unlike parents) of the fruit-fly, *Drosophila melanogaster*, during fertilisation is described and illustrated by Messrs. B. N. Sidorov, N. N. Sokolov and I. E. Trofimov. In order that homologous portions of the chromosomes may lie side by side notwithstanding the presence of an inversion in the order of the genes in one of the chromosomes, a 'loop' is formed as a result of a single crossing-over in an inverted region.

Prof. C. Białobrzeski and I. Adamczewski have found that the use of liquid dielectrics is advantageous for the study of the cosmic ray bursts. In an ionisation chamber of 1 litre capacity filled with carefully purified hexane, they observed 37 bursts in 13 hours. Several bursts are double or even of more complicated structure.

Research Items

Origin of the Domesticated Horse

IN a survey of the evidence bearing on the evolution of the modern domesticated horse, Dr. Max Hilzheimer (*Antiquity*, 1935, June) confirms the surprising inference from the bones found in the Royal Tombs at Ur that the early Sumerians had domesticated the Asiatic dziggetai or onager. Bones since found at Tell Asmar include numerous remains of the onager, but none of animals resembling the horse. There are two, possibly three, varieties of the early horse. It is represented in palæolithic art; but it was not domesticated until neolithic, and in places, bronze age times. Its habitat was north of the central Eur-Asiatic mountain chain, except for Spain, and extended from western Europe to Mongolia. Of the two varieties, the Tarpan lies west of long. 40°, Przewalski's horse to the east. An early classification divided the domesticated horse into an oriental and an occidental breed, contrasted as in the Arab and the Clydesdale; but an early breed indigenous to Europe and native to Poland is the Konink. Notwithstanding opinion to the contrary, the original home of the Arab or oriental type is Europe, its distinguishing characters being due to climate and careful breeding. The earliest representations appear on the monuments of Assyria dating to the first half of the first millennium B.C., though it had been introduced there long before by Aryan tribes. In varying form this is the horse of the Egyptians, Hittites, Greeks, Romans and Scythians. The so-called occidental horse has been thought to be descended from the prehistoric horse, of which remains are found in the glacial deposits of Central Europe; but the break in continuity precludes this view. It first appears in dual form as the Noric horse and the horse of Persepolis of the fifth or sixth century B.C. The heavy draught horse is first seen on a tombstone at Chalon-sur-Saône in the second century B.C., and there can be little doubt that, like the Arab type, it was a product of breeding and climate which appeared first in the countries, broadly, bordering on the North Sea.

The Tongue

PROF. DAVID KATZ, formerly of Rostock University, has communicated to the Manchester Literary and Philosophical Society a summary of the results of his research on the tongue as a primitive sense organ (*Mem. Manchester Lit. and Phil. Soc.*, 1933–34). All theories of evolution, however much they may differ, agree that life must have originated and developed in water and later adapted itself to conditions on dry land and in the air. Psychologically, this is manifested in the strength of our need of water. The function of perceiving wetness seems to be restricted to one organ, the tongue. The sense of taste is a specific chemical sense; and it is a near-sense as it has to have contact with the chemical stimulus without the intervention of a medium. It cannot taste solids; they must be dissolved, this being the function of the saliva. The tongue is also remarkably sensitive to an electric current. With regard to the sensations of wetness and dryness, while all the external surface of the body is dry, the internal surfaces are moist. Normally, neither wetness nor dryness is felt in a specific manner. The only part of the body which gives a real subjective impression of wetness is the tongue, while the pharynx gives a nearly permanent impression of dryness. Together they probably form a single sensory unit which as a whole plays an important part in supervising the water economy of the body. The sensation of dryness in the pharynx controls the secretion and swallowing of the saliva. With regard to electric taste, a series of experiments has shown that an opposition of taste is created at anode and cathode of sour-salty and bitter-sweet, which can also be described as relatively bright and dark or heavy and light in analogy with the impressions of other senses, while other, tingling sensations are experienced which probably represent the generation of gas. These impressions do not depend on the metal used, and whatever the combination the threshold appears at the same intensity of current.

Ecological Conditions in Coffee Plantations

UNDER the title of "The Climate and Eco-climates of Coffee Plantations" by Mr. T. W. Kirkpatrick, entomologist, East African Research Station, Amani, Tanganyika, there has recently appeared a memoir interesting to entomologists and botanists alike. The investigations concerned were undertaken in coffee plantations in Kenya Colony. After discussing the standard climate of the district concerned, the author deals with the air temperature at a height of 1·3 metres between the rows of coffee bushes, and compares it with that in the standard screen. Similar temperatures inside a coffee bush are also recorded, together with the temperatures of the leaves of such a bush and the body temperature of an insect (*Antestia*) on the surface of a bush. Soil temperatures, humidity, precipitation, evaporation, light and other factors are dealt with in detail. The author then goes on to discuss the various factors which modify the climate of a coffee plantation. It was found that, in general, the climatic conditions in a plantation differ widely from those which obtain in a standard meteorological screen, and do not always vary in the direction which might be anticipated. It is possible, however, to deduce, with fair accuracy, the extent to which these conditions will vary from a standard. The author describes the technique employed, and the data obtained, in detail. The work is an important original contribution which should be read by all ecologists and may be obtained, price 5*s*., post paid, from the Research Station at Amani, or from the Crown Agents for the Colonies, 4 Millbank, S.W.1.

A Cure for Lime-induced Chlorosis of Fruit Trees

A yellowing of the foliage of apples and pears, induced by lime, causes a considerable amount of damage in some fruit-growing areas. Dr. T. Wallace, of the Long Ashton Research Station, has shown that this state can be remedied by the simple expedient of allowing grass to grow between the trees. This is not always desirable, however, and in a recent paper he gives the results of his experiments with a new method of treatment (*J. Pomol. and Hort. Sci.*, 13,

No. 1, March 1935). The method is very simple. Holes are bored in the trunk with a brace and bit, a small quantity of ferrous or ferric citrate is placed within, and each hole is then closed with a cork. Treatment by this method has been quite successful, and has converted failing trees into healthy specimens. It only remains to investigate the duration of the treatment over a period of years.

Encroachment of the Sahara

IN a paper in the *Geographical Journal* of June, Prof. E. P. Stebbing directs attention to the serious threat to the West African colonies of Great Britain and France by the encroachment of the Sahara. This is due, not to climatic causes, but to the methods of agriculture pursued. Shifting cultivation is still the practice. A piece of forest is felled, the timber burnt and the ground is sown and ultimately harvested. When the weeds become too heavy, or the yield inadequate, the patch is abandoned and a new one occupied. Thus the deciduous forest on the verge of the Sudan becomes degraded, more open and drier. Eventually savannah supervenes, which in West Africa is a term applied to bush or scrub. Herds of the nomadic shepherds then occupy and further destroy it. When its fodder value has almost gone, the herdsman cuts the scrub trees to get fodder for the goat. This is the last stage in the ruination of the land and the advance of the desert. Prof. Stebbing traces the degradation of the forest with the associated ruin of the land in a broad belt in Nigeria and elsewhere, and strongly advocates the need of reserving a belt of degraded forest at least some fifteen miles in width and more than 1,300 miles in length, in which tree growth could be improved and further destruction checked. Thus the advance of the Sahara might be stopped.

Old Maps of Wales

A USEFUL account of the maps of Wales up to A.D. 1600 is published by the National Museum of Wales ("The Map of Wales". By Dr. F. J. North. 1*s*.). Apart from diagrammatic representations on the Peutinger Table, Ptolemy's maps and medieval mappae mundi and portolan charts, there was no map of value until the latter part of the sixteenth century, when there were published the Mercator map, the Lhuyd map and, most notable, the Saxton map. These are fully discussed. But of equal interest is the anonymous fourteenth century map known as the Gough map in the Bodleian library. Its date is uncertain but probably so early as 1340. The volume contains representations of parts of many of the early maps.

Atomic Weight of Terbium

THE isotopic composition and atomic weights of the rare earth elements as determined by F. W. Aston (*Proc. Roy. Soc.*, **146**, 46; 1934) are sometimes in marked discrepancy with the chemical values. In the case of terbium, the values are 158·91 (Aston) and 159·2 (international value). A volumetric determination of the atomic weight of terbium, with very pure material prepared by the fractionation of the dimethylphosphate, has been made by J. K. Marsh (*J. Chem. Soc.*, 772; 1935). The oxalate was prepared and the ratio $Tb_2O_3 : 3C_2O_3$ was determined by ignition and by titration with permanganate. The value derived for the atomic weight was 158·9. This assumes the atomic weight of carbon to be 12·00, but if it were raised to 12·01, the value for terbium would be raised only to 158·92. The new value, for which accuracy in the first place of decimals is claimed, is in very good agreement with that found by Aston, and hence both the chemical and mass-spectrograph methods indicate a value 158·9 for the atomic weight of terbium.

Structure of Cupric Compounds

E. G. Cox and K. C. Webster (*J. Chem. Soc.*, 731; 1935) have examined by means of X-rays the structures of some quadricovalent compounds of bivalent copper containing acetylacetone, benzoylacetone, dipropionylmethane and 3-chloroacetylacetone as addendæ. A complete determination of crystalline structure of such compounds would be very laborious, but a consideration of space-group results, cell dimensions and optical properties shows clearly that the molecules are planar, that is, the four valencies attached to the copper lie in one plane and are not tetrahedral. Since compounds in which a planar distribution has been established appear to be in no way exceptional, it is reasonable to infer that the planar configuration is normal for four-co-ordinated compounds of bivalent copper. This result, which confirms the view expressed by Werner, is not in accord with the conclusions of Mills and Gott in 1926, who obtained a strychnine salt of cupribenzoylpyruvic acid showing a small but definite mutarotation, and inferred that the valency arrangement was tetrahedral. The case for optical activity, however, rested only on analogy with the behaviour of the brucine salt of the corresponding beryllium complex. Since there is no doubt as to the tetrahedral configuration of beryllium, it seems that this analogy is false, and that the observed results of Mills and Gott were due to some cause other than a tetrahedral copper atom. According to Pauling, a planar configuration is to be expected when *s*, *p* and *d* electrons are involved in the valency bonds. It is possible, therefore, that bivalent copper possesses a complete 3_3 sub-group of ten electrons, some being shared, instead of an incomplete group of nine, as is usually supposed. This would involve one unpaired electron in the fourth principal quantum level, giving rise to a paramagnetic moment of the same order as that which has been found.

Nova Herculis

DR. A. BEER has published (*Mon. Not. R.A.S.*, **95**, 538) a light curve of Nova Herculis from the time of its discovery (December 12, 1934) up to April 3, 1935. This is based on visual or photometric measures by numerous observers and shows well the main features of the changes observed, including the steep rise just after discovery, the rapid fluctuations with a very slow average decrease, until the final spectacular drop of more than five magnitudes within a few days. The more recent recovery from the thirteenth to the eighth magnitude is not covered by the range of dates discussed. Measures of the spectra taken at Cambridge on these dates with the 15-in. Huggins refractor over the visual region from $H\beta$ to a little beyond $H\alpha$ (7331 A.) are included. About 150 emission lines or bands have been measured in this region, for the majority of which probable identifications are given, with the origins of other possible blending lines. Laboratory intensities and multiplet classifications are given for all the origins suggested.

Excavations at Tell Duweir, 1934-35

EXCAVATIONS at Tell Duweir, the Biblical Lachish, in the third season of the Wellcome Archæological Research Expedition to the Near East, of which Mr. J. L. Starkey is director, carried on the further exploration and clearance of the cave-dwelling settlement of the Early Copper Age which lies to the north-west from the Tell, the clearing of the temple and shrine outside the city walls at the north-west corner of the Tell, which was discovered last year and then shown to be contemporary with the xviii and xixth Dynasties of Egypt, the completion of the examination of the Iron Age cemetery to the south-west, the further clearance of the gate at the south-west corner of the Tell, with its subsidiary works, and further work on the summit of the mound, which included the clearing of the Persian shrine of the Sun. A considerable amount of labour was also expended on retaining walls for terracing the west side of the Tell and other necessary work for the disposal of the material to be removed in the course of excavation.

The season's finds have more than justified expectations based upon estimates of the importance of the site, apart from its size; and interesting as were the finds of last year, especially the discovery of the shrine with its associated examples of a localised art, reminiscent of Tell el-Amarna, and the fragments of the ewer inscribed with a primitive script showing affinities with the famous Sinai script, the results of the season recently closed show no falling off in interest. Indeed in certain respects, more particularly in the importance and the immediate applicability of the epigraphic material to Biblical studies, they may even be said to transcend previous discoveries. In addition, the epigraphic material has provided direct documentary evidence confirming the identification of Tell Duweir with Lachish.

The evidence which comes from the area to the north-west of the Tell, including what has been termed the prehistoric suburb, continues to point to a surprisingly extensive settlement and relative density of early prehistoric population. Further excavation in the cave-dwelling area of the æneolithic period has produced additional examples of the characteristic red ware in a variety of forms. One remarkable example is a very large jar, approaching a metre in height, which now has been reconstructed. It shows the peculiar feature of a vertical fissure or gap, of which the worn edges point to the use of the jar in two separate halves for some considerable time. With a number of carefully and beautifully formed flint knives, hoes and sickle blades with serrated edge were implements of pure copper. Of these last one was a remarkably well-preserved copper dagger, which had been beaten to a high degree of hardness and is among the earliest known from Palestine.

On the whole, the pottery of the Copper Age is at its best in the earliest period. In common with other elements in the culture, it shows a progressive deterioration as time goes on. One example of such degeneration, to which attention was especially directed in the collection of pottery dating from 3000–2000 B.C. shown at the Wellcome Research Institution, was to be seen in the form of the characteristic ledge-handles on either side of certain types of vessel. Throughout the period, from about 2800 B.C. onward, these dwindle away until they become the merest vestigial trace without apparent meaning. An interesting suggestion as to the purpose of these remarkable, if characteristic, ledge-handles has been put forward by Mr. Starkey, who thinks that they may have served as a grip to enable solid sediment, such as that which would be left by beer, to be shaken from the vessel.

In clearing the temple and shrine lying outside the walls at the north-west, evidence was found, strange to say, of a degradation somewhat similar in character to that deduced from the finds of the Copper Age. Three temples had been erected on the site. Between the erection of the earliest before 1400 B.C. and the destruction of the third in 1260 B.C., there is a progressive decline in the character of the temple and in material employed in the shrine and its appointments. It will be remembered that one of the most remarkable features of this discovery, apart from the character of the shrine as a whole, were the ivory carvings and carved inlays, which in style recalled the art of Tell el-Amarna, but were attributed to a local school of art. While the main characteristics of the cult appear to be constant, the inlays first change to bone, copying, but in a debased form, their ivory originals, and then, in the period of the third temple, clay figures appear. In like manner, in the last phase, the probable portable altar of the second shrine becomes a solid structure of brick, and the shrine itself is but mud lime-plastered.

Ivory rods of unknown use also appear in shortened form in clay. It has been suggested, however, that clay, which could be heated, would be a more suitable material, if these rods were, as conjectured, used for making the closely curled ringlets in hair and beard which adorn the inhabitants of Palestine in the Assyrian bas-reliefs.

Among the tombs of the Early Iron Age, or Solomonic period, an outstanding find was one which, there is reasonable ground for concluding, contained the mortal remains of a priest or minor official of the temple. This conclusion rests on the evidence of a remarkable three-pronged fork or trident of iron which lay at the entrance. It is some two feet in length and has a short handle. Its form immediately suggests a "flesh hook" for lifting meat from an offerings bin, such as that to which reference is made in *Samuel* I, ii, 13–14. Associated with this burial was an interesting collection of beads and a small ivory tablet, in which thirty holes in three vertical columns may have served as a memorandum or calendar to mark the feast days of a thirty-day month.

Before dealing with the finds which follow here in strict chronological order, a brief reference must suffice for the finds of the Persian period from the shrine of the Sun God. Among these were some striking zoomorphic figures in clay and some equally remarkable miniature altars of stone, on which were crude engraved designs of men, trees and animals.

What is beyond question the most important discovery of the season is epigraphic and historical, rather than purely archæological in interest. A fragment of pottery inscribed in the same primitive script as that of the inscription on the fragmentary

ewer found last year has added three characters to those previously known. Even more important, however, to the historian and Biblical student, is a series of letters which belongs to the period immediately before the destruction of the city by Nebuchadnezzar in 598 B.C. The letters, mostly complete, and in some instances running to some length, are on seventeen ostraka which were found among the debris of the guard-room of the gate giving access to the fortress at the south-western corner of the Tell. They are written in ink in an early form of Hebrew, and according to a decipherment and translation made by Prof. Harry Torczyner, of the University of Jerusalem, were addressed to the commander of the garrison of Lachish from a subordinate command. One letter is much concerned with the observation of signals and suggests that it refers to a system of smoke signals by which communications were maintained between Lachish and the supreme command. This letter also refers to Lachish by name.

In a list of names of individuals in the correspondence a form compounded with *yahu*—a form of invocation of Yahweh (Jehovah)—predominates; but one among the names of the fathers of the individuals cited is given, not as a yahu compound, but as an El-compound (El-Natan). This points to a change from El to Yahweh worship within the lives of father and son, probably a result, it is suggested, of the reforms of Josiah. Of even greater interest to Biblical scholars is a reference to a prophet who had been the cause of disturbance, and the passing of a commander-in-chief, Akhboryahu, son of El-Natan, on his way to Egypt, which is clearly a reference to persons and incidents mentioned in *Jeremiah* xxvi, 20–22.

Scientific Management

THE papers given at the Sixth International Congress for Scientific Management held in London during the past week have been available in print for members since early in May (Secretary of the Congress, 21 Tothill Street, London, S.W.1). They are published in six volumes corresponding with the six sections of the Congress and are grouped under subject headings relating to the particular themes to be considered at the four sessions held by each section. Nearly all the 200 papers have a certain scientific interest, so that any selection from them is difficult.

Dealing with the subject of preliminary education for management, Mr. A. P. M. Fleming points out that at present provision is seldom made in industrial concerns to ensure continuity of good management beyond a single generation. The methods of selection of staff are discussed by competent authorities from the German, French, British, Dutch, Italian and Swiss points of view, so that a comprehensive picture of modern thought on this subject is available. When summarised, the information should be of great importance to educational advisers who have to help to place young men in life.

Opinion is hardening in business circles that the entrants from school should receive a good deal more vocational training than at present. The recruitment of personnel suitable for high administrative positions is likewise discussed in several papers. The National Institute of Industrial Psychology is responsible for a communication which deals with the vexed question of promotion versus engagement from outside on the basis of the experience gained by the Institute, and schemes are put forward showing how to discover men within a company for training and how to select from outside. The Dutch authors regard personnel selection as a profession in itself: the Italians would invoke a psychotechnical criterion.

It is widely said that there is a shortage of men to-day for the senior posts, probably because of the toll taken by the War of the more enterprising. It is clear that there is world-wide concern with regard to leadership: hence the numerous suggestions as to the form of training. The volume containing the educational and training section papers deserves to be read as a whole both by executives who have the choice of their successors and by the educationists.

In the development section the bulk of the papers discuss the correct methods of inculcating modern management principles and practices. They come from many lands and cover a variety of problems. Thus C. G. Renold describes the steps taken in the merging and subsequent rationalisation of a group of companies employing 5,000 people; he attempts to assess the costs involved and the benefits resulting: this is a most valuable contribution. H. J. Mitchell discusses the methods adopted by Imperial Chemical Industries, Ltd., of which he is a leading director, in the management of its many activities, the general desire being to have a stable organisation where stability is essential but a high degree of flexibility in other directions where research and development require it. Whereas management of the groups is decentralised, finance is fully centralised. The Company's whole-time directors are relieved of direct executive duties, and a considerable amount of authority and responsibility is delegated. This account of the management of our largest undertaking contrasts with one, describing the methods used in a small tapestry factory, which follows it.

The account of the I.C.I. scheme of management will be widely studied, the more so as it is realised both that the problem of the successful management of so large an organisation is one of very great difficulty and that the difficulties have been largely overcome by I.C.I. along the lines outlined.

A second series of papers in this volume deals with the rôle of institutions, trade and other associations in relation to management problems. A thoughtful summary contributed by a committee representing the Federation of British Industries analyses the association movement as affecting efficiency, and makes some constructive suggestions as to the manner in which trade associations can be of assistance.

In the manufacturing section the subject of budgetary control attracts first notice. An important review representing the accumulated experience of some of the leading firms in Great Britain is contributed by Roland Dunkerley. The idea indicated by the term is to substitute considered intention for opportunism in business; it has been much discussed and studied during recent years, and the theories of

such control are firmly established and widely known. Its application is proving increasingly successful though it is necessary to adjust the principles to meet the varying demands of the various industries.

A second group of papers deals with scientific methods applied to works management in a number of specific examples.

Distribution is becoming very definitely a science. It is axiomatic that the manufacturer of a new product must sell it and that the true market is always the ultimate user. A paper contributed by the Advertising Association of Great Britain gives a particularly good summary of the routes through which a new product can be distributed to the public, with concrete examples of recent introductions. Any reader of this volume who has the task of introducing a new product can easily ascertain the international views as to how he should begin his task. Large organisations are finding it worth while to establish special departments for marketing research: some of the methods employed and results obtained in the United States are described by Mr. O. F. Roost. As one industry after another reaches a point where it is able to produce more than the market can apparently consume, competition becomes keener and the need for more intimate and accurate knowledge of existing markets and possible new ones becomes apparent.

E. F. A.

The Metallic State

A CONFERENCE on "The Metallic State" was held in the University of Bristol at the H. H. Wills Physics Laboratory on July 2–5, about forty visitors being present from other parts of England and from the Continent. Most of the visitors were housed in Wills Hall, one of the University halls of residence.

At the opening session of the Conference, Dr. J. A. Prins (Groningen) gave an account of the results obtained at the University of Groningen on the absorption and emission of X-rays by metals. The absorption spectrum in crystalline solids has a fine structure extending several hundred electron volts on the short wave-length side of the edge, and depending in its general features only on the structure, and not on the atomic constitution of the crystal. A theoretical explanation due to Kronig was discussed, which relates the phenomenon to the Bragg reflection of the ejected electrons. Dr. H. W. B. Skinner (Bristol) showed how the study of emission bands in the ultra-soft region can give information about the occupied electronic states in metals. Prof. W. L. Bragg (Manchester) gave a report of some recent results obtained by Sykes on the formation of a superstructure in copper-gold alloys, and Mr. J. D. Bernal (Cambridge) discussed the factors which determine the crystal structure of alloys, pointing out especially that the atomic radii of the constituents have often a decisive influence.

The morning of July 3 was devoted to a discussion of the liquid and amorphous states. Prof. H. Mark (Vienna) gave an account of recent theories of electrical conductivity, and Dr. J. A. Prins gave a report on his own work on amorphous antimony. Dr. G. W. Brindley (Leeds) showed the effect of filing on the intensity of X-ray reflection from metals. In the afternoon there was a discussion on the properties of metallic bismuth, in which Prof. A. Goetz (Pasadena), Dr. N. Thompson (Bristol), Dr. D. Shoenberg (Cambridge) and Dr. H. Jones (Bristol) took part. Bismuth is peculiar in that very small quantities (less than 0·1 per cent) of lead, tin or other metals in solid solution have a very marked effect on its electrical conductivity and diamagnetic susceptibility. Prof. Goetz expressed the opinion that these facts suggest the existence in bismuth of a microcrystalline superstructure of the kind postulated by Zwicky, but an alternative explanation was suggested in terms of the wave mechanical theories due to Peierls and Jones. These theories, however, will require further development before any quantitative account of the facts can be given.

On July 4, Prof. W. Gerlach (Munich) gave an account of the work carried out in his laboratory on the electrical resistance of nickel and of some of its alloys. The resistance of nickel decreases in a magnetic field, the decrease being proportional to the change in σ^2, where σ is the magnetisation. Further, the resistance plotted against temperature shows a kink at the Curie point. A possible explanation of the effect was suggested by Prof. N. F. Mott (Bristol). Dr. E. C. Stoner (Leeds) pointed out that various methods of determining the Weiss intramolecular field constant in nickel give very discordant results, and suggested an explanation.

On July 5, a discussion on supra-conductivity was opened by Dr. J. M. Casimir (Leyden), who gave an account of the fundamental experiments of Meissner, and of de Haas and Mrs. Casimir, and of the important theoretical advances of Gorter, Casimir and London. Mr. K. Mendelssohn (Oxford) gave an account of the behaviour of certain alloys. It appears that though great progress has been made towards the understanding of the thermodynamics and electrodynamics of a supra-conductor, we are still as far as ever from knowing the cause of the phenomenon. Dr. H. Niewodniczański and Mr. C. J. Milner (Mond Laboratory, Cambridge) discussed the electrical conductivity of non-supra-conductors, and here also the results of theory are by no means in accord with experiment, and the opinion was expressed on several sides that all theories are wrong below 4° K. Prof. F. Simon (Oxford) and Dr. E. Teller (London) also discussed the possibility of using nuclear spins to obtain yet lower temperatures than can be obtained with ordinary paramagnetics by the magnetic cooling method.

An interesting feature of the Conference was the frequent mention of experimental facts for which no quantitative theoretical explanation could be given. Considerable advances have recently been made in the quantum theory of the metallic state, and it is now possible for the theorist to give an indication of why certain metals have their particular crystal structures, magnetic properties and electrical conductivities. Nevertheless, the theory is as yet far from being able to give such a complete account of the experimental data as is possible, for example, in the field of atomic spectra.

Biology at the Imperial Social Hygiene Congress

AT the recent Congress held under the auspices of the British Social Hygiene Council at the London School of Hygiene and Tropical Medicine, the teaching of biology formed the main topic of the papers read during the educational sessions. It is satisfactory to hear from Dr. E. W. Shann that it is now realised that there are two categories of pupils to be considered in the drafting of syllabuses, namely, those for whom biology is a necessary part of their general education, and those who require it for vocational reasons. Up to an early stage, the needs of these two may be regarded as identical; and they will probably be met by a well-balanced course of general elementary science in which hygiene and the functions of the chief organs of the human body should certainly be included. The scheme advocated by Mrs. E. J. Hatfield, which is already in use in many girls' schools, and deserves the attention of others where the ages of pupils permit is: Age 11–12 years, general elementary science; age 12–14 years, chemistry, or chemistry and physics; age 14–16 years, general biology, and in addition, chemistry or physics for future science specialists.

For purposes of general education, biology is unquestionably preferable to either zoology or botany; and that this is becoming more widely recognised by teachers is shown by the steady increase in the number of candidates offering biology at certificate examinations, and the corresponding diminution in that of those offering either of the other subjects. A knowledge of the structure and life-histories of a few typical animals and plants does not bestow on its possessor a biological outlook on the world around him and on the problems of mankind: the type system is dead so far as general education is concerned. It is biological topics rather than types that will eventually produce a biologically minded public, and, it is to be hoped, lead to social legislative measures based on the conviction that man is subject to the same laws of Nature as are all other animals.

The topics that are essential in such a course are (1) food elaboration by green plants, the source of all vital energy and conversions of energy; here is abundant opportunity for personal experimental work, even on the large scale, in rural schools possessing gardens; (2) the structure of a mammal, and the functions of the chief organs; (3) reproduction, asexual and sexual, in plants and animals; parental care, and its importance in evolution; (4) the web of life, and mutual interdependence; heredity; evolution; biology in the service of man; (5) bacteria and fungi, and their rôle in the nitrogen- and carbon-cycles.

It is obvious that mammalian physiology will be human; nor is any apology for this necessary. A child is naturally and properly curious about the workings of its own body, and most children are keenly interested in living animals, and perhaps also in growing plants. Thus it becomes easy and not inappropriate to digress from the processes going on in the body of the living child to the methods by which the same processes are effected in other animals and in plants. For example, human respiration may well be followed by the methods of respiration found in, say, fish, snails and insects, and by demonstration of the fact that in plants respiration is essentially the same as in animals. Similar digressions can be made in connexion with all the other metabolic processes, which need not here be specified. In such a course, instruction on the details of structure would be reduced to the barest minimum; morphology is for the specialist, not for the general public; and the topics would be purely biological, and freed from the type incubus.

It is generally conceded that biological teaching is the best method of instructing in the laws of health and in the meaning of sex. Indeed, in some quarters sex-instruction has been the chief reason for advocating the inclusion of biology in all school curricula. Certainly knowledge of the sexual processes in plants and in the lower animals affords an avenue by which approach may be made to the relation of male and female in the human species; but to stress this aspect in a course of general biology is a mistake; the functions of the reproductive system should have neither more nor less attention devoted to them than is given to those of the digestive, respiratory, excretory and the rest.

What matters most is that for all the processes of life there should be instilled a respect, a reverence for the mystery of life, an appreciation of the beauty of the form of living things and of their marvellous adaptations to their environment. Knowledge without the spirit of reverence will not have much influence on the moral conduct of man or of woman.

It is, then, very desirable that training colleges should emphasise this aspect of biology, and should insist on this subject being included in the science course; for the lack of qualified teachers has not yet been made good.

The Museums Association

ANNUAL CONFERENCE AT BRUSSELS

THE Museums Association, which has its headquarters in London, and holds its annual conference at different provincial centres in turn, this year departed from its usual custom, and, at the invitation of the Belgian Government, held its Conference in Brussels, where more than two hundred members assembled.

After the Sunday had been spent in visiting the city and its museums, formal proceedings began on Monday, July 1, when members were officially

welcomed by the Belgian Minister of Education. Sir Eric Maclagan, director of the Victoria and Albert Museum, then gave his presidential address on "The Future of Museums". The increasing tendency in Great Britain for private collections to become absorbed into the public museums of the country, and the continued growth of the latter, has created, he said, a very serious problem, since ultimately the limit is reached beyond which expansion is practically impossible. Those in charge of museums must therefore become more and more selective in the choice of material. The principle whereby the contents of a museum are divided into public collections, exhibited with great care, and study collections available to students, is an ideal one, but it is practically impossible to adapt existing buildings to such a purpose. Another method of limitation, which could be applied to smaller museums, is that of specialisation, whereby individual museums would carry some groups of exhibits as near completion as possible. Museum federations offer opportunities to promote this by means of exchanges.

Above all, Sir Eric said, those in charge of museums should look forward and regulate their own activities with a view to those of their successors. If anything is to emerge unscathed from our troubled times, museums have a higher 'survival value' than almost any other contemporary institution.

The address was followed by a paper from Prof. Jean Capart, *conservateur en chef* of the Musées Royaux d'Art et d'Histoire, on "The Museum Spirit", which is, he said, to restore the voice to the dead. The scientific aspect of museum work is only a beginning; truth must not remain the personal benefit of the scholar, but must be widely distributed.

In the afternoon there were organised tours of the various departments of the Royal Museums of Art and History in Brussels, where in the evening a reception was held.

On the following day, Prof. F. Demanet, of the Musée Royal d'Histoire Naturelle, opened a discussion on "What is the best way of forming a palæontological collection?" The answer is, he believes, by means of regional investigations carried out by specialists, who would note every fact throwing light on the stratigraphy, palæobiology and ecology of the specimens collected. The collection of specimens should, in fact, become a science of observation. After this subject had been discussed by Drs. D. A. Allan and J. W. Jackson, of the Liverpool and Manchester Museums respectively, Dr. W. T. Calman, of the British Museum (Natural History), gave an illuminating account of the planning of the new Whale Room at that Museum, and Mr. K. de B. Codrington rounded off the morning by a scholarly and witty paper on "The Making of Museums".

The afternoon was kept free for visits to the Museums of Fine Arts and of Natural History (the latter remarkable for its fossil vertebrates), and in the evening members were the guests of Burgomaster Max at the Hôtel de Ville.

On Wednesday, July 3, the Museums Association was privileged to attend the centenary celebrations of the Musées Royaux d'Art et d'Histoire, at which Their Majesties the King and Queen of the Belgians were present. After lunch, a visit to the Congo Museum at Tervueren showed how admirably a single Museum could cover all aspects of the Belgian Congo—its history, natural history, economic resources, ethnography and art—and also provided an enjoyable excursion through the Forêt des Soignes. The annual dinner was held in the evening.

The meetings on Thursday, July 4, took place at the International Exhibition at Brussels. After Mr. P. Dikaios had given an account of the reorganisation of the archæological museum at Nicosia, Cyprus, and Dr. H. J. Plenderleith, of the British Museum, had discussed the application of scientific research to the study of works of art—in which he pointed out that the scientific specialist needs a knowledge of painting if he would avoid errors when working in this field—visits were paid to the magnificent collection of "Art Ancien" and to the other attractions, scientific, artistic and popular, of the Brussels Exhibition.

Friday and Saturday mornings were devoted to excursions to Antwerp, with its unique Museum of Printing, the Musée Plantin-Moretus, and to Bruges, where the effective design of the new municipal museum was greatly admired.

During the Conference, meetings were very well attended, in spite of the many counter-attractions of Brussels, of its museums, and of the Exhibition, and at the end of the week those who took part returned to England agreed that the decision to meet abroad had been fully justified by the success of the meeting.

The next annual conference of the Association will be held at the Leeds City Museum and Art Gallery, in July, 1936.

Educational Topics and Events

BELFAST.—At the graduation ceremony on July 10, honorary degrees were conferred upon, among others, Prof. T. G. Moorhead, regius professor of physic, Trinity College, Dublin; Dr. T. Carnwath, senior medical officer, Ministry of Health; Major-General W. P. Macarthur, Deputy Director-General, Army Medical Services; and the degree of D.Sc. was conferred on J. B. Parke for work on the viscosity of emulsions.

DUBLIN.—On July 5 the University of Dublin conferred the following honorary degrees: D.Sc.—Prof. G. T. Morgan, director of the Chemical Research Laboratory at Teddington. Litt.D.—Sir Frederic Kenyon, formerly director of the British Museum. M.D.—Prof. T. H. Milroy, professor of physiology in Queen's University, Belfast, and Sir Norman Walker, direct representative for Scotland on the General Medical Council.

LIVERPOOL.—At a meeting of the Council on July 9, Mr. Thomas Bertrand Abell, professor of naval architecture and dean of the Faculty of Engineering, was appointed pro-vice-chancellor of the University for the session 1935–36. Prof. Abell, who has occupied the chair of naval architecture since 1914, had a distinguished career at the Royal Naval College, Devonport, and has held various appointments under the Admiralty, at the Royal Naval College, Greenwich, and the Royal Naval War College, Portsmouth. During the War he was assistant director of designs to the Admiralty and Ministry of Shipping and was awarded the O.B.E. for his War services.

The Council has also appointed Mr. J. F. Craig to the William Prescott chair of the care of animals as from October next. Mr. Craig has been on the staff of the Veterinary College of Ireland since 1903, having succeeded to the position of principal in 1918.

He has been president of the Royal College of Veterinary Surgeons and is now president of the National Veterinary Medical Association of Great Britain and Ireland. Mr. Craig has been responsible for important researches into diseases of animals in the Irish Free State and has contributed extensively to scientific literature.

SHEFFIELD.—The following appointments have been made: Mr. J. MacD. Croll, to be lecturer in bacteriology; Mr. Mansergh Shaw, to be assistant lecturer in mechanical engineering; Dr. Edward S. Duthie, to be a demonstrator in pathology.

To universities, and the causes they stand for, the series of special university supplements now in course of publication by *Time and Tide* are doing a really valuable service. The third of the series, published with the issue of April 27 under the heading "More and More of Less and Less", elucidates a number of problems, all of first-rate importance, associated with the growth of specialisation in universities. Mr. R. H. S. Crossman's article on "The Problem in Philosophy" sketches with firm lines the situation confronting the modern student of philosophy. Lacking a comprehensive grasp, such as he cannot hope to compass, of the structure of modern scientific thinking, he tends to subside into the rut of history of philosophy on traditional lines or to give himself up to the exploration of the mazes of logistics. A better way is, however, open to him, pending the discovery of means whereby he may be equipped for holding converse with mathematical and physical scientific workers on their own ground: the study of politics and ethics, not *in vacuo* but in relation to contemporary issues. Mr. C. M. Bowra, discussing science and the humanities as studied in the older universities, suggests, *inter alia*, the institution of a course analogous to Oxford's "Modern Greats" combining with philosophy, physics or biology or chemistry. Three other articles deal mainly with conditions of study, in some respects deplorable, in the modern English universities: by Prof. E. R. Dodds on "Departmentalism and Humane Culture", Mr. Pilley on "The Universities and Science" and Mr. Mansell Jones on "'Facts and Skills' or Education". Lastly comes a study of the situation at Durham. A brief retrospect of the salient features of the history of this university is made to illustrate causes and effects of specialisation, and the recent Royal Commission's recommendations are used to point a moral and adorn a tale.

Science News a Century Ago

Progress of Colonel Chesney's Expedition

IN his expedition to the Euphrates in connexion with the project of shortening the passage to India by means of steam navigation, Colonel Chesney had met with some opposition from the Pasha of Egypt, who, however, had given way, and in a letter from "Port William" on the upper Euphrates, dated July 21, 1835, Chesney remarked, "We arrived here four days ago, and the spot where we are at work, has been named as above, in honour of our earliest patron, the King. We are making efforts of no common kind to get afloat, so as to reach Bussora in time to sail from thence upwards, about the 30th of September".

"I put up the little steamer at the Orontes as a sort of hint, that we did not mean to be stopped, but his Highness gave way, and instead of making our steamer take the gear up to Antioch, we broke her into eight sections, and placed them on keelsons and other pieces of timber, with wheels underneath to make their way by land. . . ."

"I do not expect to finish the steamer before we sail downwards, but she will probably be decked and in working trim, as a shell, in which we must rough it as is done here where there are a couple of habitable rooms, some sheds covered with branches, and tents . . . and the whole enclosed by a parapet and ditch, which were thrown up and just completed by one of the officers. . . ."

The Horticultural Society

ON July 21, 1835, a paper was read to the Horticultural Society, by J. Disney, "On the Preservation of the Golden Harvey Apple," a variety so well known for its excellence and general utility that a really good plan for prolonging the period of its maturity was a desideratum.

It was announced that the annual gold medal about to be given by Lord Grey of Groby, for the finest orchideous plants exhibited, had been adjudged to Mr. James Bruce, gardener to Boyd Miller, Esq., of Mitcham, for an extremely fine plant of *Oncidium ciliatum* with forty-four flowers in its panicle which was shown at the meeting on November 4, 1834 (*Athenæum*).

Lyell and the Continental Geologists

WRITING from Paris to Sedgwick on July 23, 1835, Lyell said: "I found here Von Buch, E. de Beaumont, Dufresnoy, Constant Prévost, Virlet, Boué, Alex Brogniart, and have had much talk with all of them, and some warm discussions with Von Buch and de Beaumont. Of the first, I must say that I found much to like in him. As I had handled some of his opinions very roughly, and as he is too much accustomed perhaps to have unbounded deference paid to him by most of his own countrymen, and by no one more so than E. de Beaumont, I had no right to expect a very cordial reception, but he met me with great frankness, and at once set me at ease by vehemently protesting against my numerous and crying heresies, none of which, not even the elevation crater theory, seems to have exacted so much honest indignation as my recent attempt to convey some of the huge Scandinavian blocks to their present destination by means of ice. . . ."

James Bowman Lindsay's Electric Light Experiments

THE *Dundee Advertiser* on July 31, 1835, said: "Mr. Lindsay, a teacher in town, formerly lecturer to the Watt Institute, succeeded on the evening of Saturday, July 25, in obtaining a constant electric light. It is upwards of two years since he turned his attention to this subject, but much of that time has been devoted to other avocations. The light in beauty, surpasses all others, has no smell, emits no smoke, is incapable of explosion, and not requiring air for combustion can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly calculated for flax houses, spinning mills, and other places containing combustible materials. It can be sent to any convenient distance, and the apparatus for producing it can be contained in a common chest".

Societies and Academies

PARIS

Academy of Sciences, June 3 (*C.R.*, 200, 1893–1996). LUCIEN CAYEUX: The constitution of the Senonian phosphates of Palestine and Transjordan. LOUIS JOUBIN: The plankton cephalopods of the Atlantic Ocean (cruises of the *Dana* in 1921–22). ANTONIN GOSSET and IVAN BERTRAND: The utilisation of a segment of marrow as a heteroplastic graft of the peripheral nerves. SERGE BERNSTEIN: Some extremal properties of successive integrals. EMILE MATHIAS: The curvature of the diameter of the densities. JEAN CABANNES: The red lines of oxygen in the nocturnal sky. RENÉ MAIRE and ERNEST WILCZEK: The vegetation of the western Sahara. HUSNI HAMID: Regular varieties of higher order. SIMON DE BACKER: A new form of the equations of the dynamics of gases. GEORGES DURAND: The exactness of Eddington's mass-luminosity relation. CHARLES BORY: The natural convection of wires: the existence of a new state of convection. With a very fine wire (25 microns), measurements of the convection coefficient indicated the existence of two regimes. PIERRE VERNOTTE: The laws of convection. Theoretical discussion of the experimental results in the preceding communication. JEAN VILLEY: The calculation of the energy loss on combustion. LÉON DUBAR: The influence of vapours and occluded gases on the electrical conductivity of cuprous oxide. The electrical conductivity of compact cuprous oxide is reduced by water vapour. JEAN GENARD: The action of the magnetic field on the absorption bands of the molecules of sulphur. FRED VLÈS and ERWIN HEINTZ: The infra-red spectrum of protein substances. HENRI MURAOUR and GABRIEL AUNIS: The agreement between the calculated and experimental pressures for explosive mixtures giving rise to gases rich in steam. MARCEL LECOIN: The β-radiation of actinium C'', of mesathorium 2 and of uranium X_1 and its derivatives. MME. LUCILE S. MATHIEU-LÉVY: The spectrophotometric study of the adsorption of copper in ammoniacal solutions by precipitated ferric hydroxide. WILFRIED HELLER: The determination of atmospheric ozone by fluorescein. This has advantages over the iodometric method; but may give high values owing to the presence of oxides of nitrogen in the atmosphere. EMILE ELCHARDUS and PAUL LAFFITTE: The constitution of the magnesium-zinc-silicon alloys rich in magnesium. MME. LÉONE WALTER LÉVY: The basic magnesium carbonates. MME. ZINA SOUBAREW-CHATELAIN: Mannitodimolybdic acid. The complex acid, the existence of which had been deduced from physical measurements by Honnelaître, has been isolated and has the constitution $H_2Mo_2O_7,C_6H_{14}O_6,H_2O$. GEORGES RICHARD: Contribution to the study of the α-halogen ketones. HENRI LONGCHAMBON and GEORGES MIGEON: The definition of the sepiolites. STOYAN PAVLOVITCH: Study of the Zlatibor gabbros (western Serbia). RENÉ PERRIN: Metamorphism generator of folds. JEAN LOMBARD: The geological structure of central Oubangui-Chari. GABRIEL LUCAS: The age of the Djebel Tenouchfi (Department of Oran) layers. JEAN DRESCH: The recent formations of Haouz de Marrakech. PAUL DELEAU: The facies of the lower Cretaceous of the region of Hammam Meskoutine (Constantine). GEORGES DENIZOT: The tectonic of the Nerthe and the Etoile, near Marseilles. GEORGES CORROY: The bases of the Hercynian massifs of the neighbourhood of Toulon. WILLIAM HENRI SCHOPFER: Generalisation of the auxogen action of the vitamin B_1 on a micro-organism. ROBERT BONNET and RAYMOND JACQUOT: Evolution of the culture media in the growth of *Sterigmatocystis nigra* as a function of the age of the mycelium. RAOUL COMBES: Nitrogen nutrition of the flower. RENÉ SOUÈGES: Embryogeny of the Rosaceæ. Development of the embryo in *Potentilla reptans*. CHARLES CHABROLIN: Germination of the seeds and plant hosts of *Orobanche speciosa*. EMILE MIÈGE: Influence of cold on the conservation and productivity of the potato. Maintenance of the tubers at 4°–5° C. for several months had a favourable effect on all the varieties examined: the state of preservation was perfect and the productivity high. RAOUL LECOQ: In a balanced ration, can the corresponding fatty acids be used instead of glycerides? They cannot. DAVID NACHMANSOHN, JACOB WAJZER and MLLE. RUTH LIPPMANN: The effect of adrenaline on the metabolism of isolated muscle. MME. VERA DANTCHAKOFF: Experimental sexual inversion of the testicular element in the embryo of the fowl. CAULLERY: Remarks on the preceding communication. VICTOR PLOUVIER: Researches on the isomerisation of cyanogenetic heterosides. MICHAEL A. MACHEBŒUF and HENRY CASSAGNE: Chemical studies on the diphtheria bacillus. Fractional extraction of the lipids of the bacillus; separation of the haptene fraction; the presence of soap in the bacillary bodies. ALBERT GORIS and HENRI CANAL: The presence of 2.oxy.5.methoxyacetophenone in the essence of the rhizomes of *Primula acaulis*. FRANCIS RATHERY, LOUIS ROY and MICHEL CONTE: The spontaneous variations of the glycæmic curve of diabetics. JEAN CUILLÉ CHELLE and BERLUREAU: The existence in France of a bovine anaplasmosis of indigenous origin.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 2, 1935). M. KRAVTCHUK: An algebraic point in the problem of moments. A. POPOV: (1) On some series. (2) Series containing cylindrical functions. V. KUPRADZE: The problem of unity in the stationary marginal problems of the theory of elasticity. V. ANTONOV-ROMANOVSKIJ: The influence of an unequal distribution of phosphorescence centres and of related factors on the dimming of the Lenard phosphorus. M. KORSUNSKIJ: (1) The curve of mass defect in the heavy elements. (2) Deviations from the Sommerfeld formula for the *k*-levels. A. ZAICEV and G. SPIVAK: On the exchange of energy between atoms of neon, argon and mercury, and a solid wall. N. SELJAKOV and E. SOVZ: The nature of 'recovery' in metals and of the re-crystallisation in monocrystals of aluminium. I. KNUNJANC and M. GERCHUK: The condensation of the α-formyl-succinic ester with esters of α-haloid-substituted acids. I. KITAJGORODSKIJ: Theory of glass manufacture. D. BELJANKIN: Influence of mineralisers on the formation of sinter-corundums. M. CHAJLAKHJAN: The permeability of the plasma in the leaves of spring and winter wheats. M. CHAJLAKHJAN and V. ALEXANDROVSKJA: The nature of photoperiodic after-effect (induction) and on the effect of the length of day on the activity of the oxidising enzymes. M. SHKOLNIK: The need of plants for boron. E. MININA: The influence of the technique of distributing fertilisers on the quality and yield of wheat.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 181–234, April 15). CARLETON R. BALL: New varieties of Western [American] willows. LINUS PAULING: The oxygen equilibrium of hæmoglobin and its structural interpretation. Assuming that the hæmoglobin molecule contains four equivalent 'hæmes', one equation involving two constants is derived which represents the oxygen equilibrium at constant hydrogen ion concentration, and another similar equation which represents the change of oxygen equilibrium with change of hydrogen ion concentration. These equations give curves agreeing well with experimental curves; they support the view that the four 'hæmes' lie at the corners of a square. B. S. HENRY and A. M. PARTANSKY: The rate and extent of anaerobic decomposition of sulphite waste liquor by bacteria of sea bottom mud. (2) Bacteriological. A number of anaerobic and facultative bacteria were isolated; they seem to be new species. Sulphite waste liquor slows down the growth and fermentation of nine common micro-organisms tried; it is fermented to only a limited extent by these organisms. C. C. TAN: Identification of the salivary gland chromosomes in *Drosophila pseudo-obscura*. CURT STERN: The behaviour of unstable genic loci—a hypothesis. The unstable locus is assumed to be a composite of a gene in its normal locus and its mutant allelomorph laterally attached next to it, the effect being different from that produced when the two genes are located in different chromosomes. J. T. BUCHHOLZ, A. F. BLAKESLEE and A. G. AVERY: Pollen-tube growth of a translocation of the 1·2 chromosome in *Datura*. Translocation was produced by exposure of pollen tubes to radon during their passage through the style. Reduction in rate of growth of pollen tubes from plants carrying the extra chromosomal material appears to occur and is roughly proportional to the amount of extra material present. CHESTER STOCK: Insectivora from the Sespe uppermost Eocene, California. S. LEFSCHETZ: Application of chain-deformations to critical points and extremals. J. W. ALEXANDER: Note on Pontrjagin's topological theorem of duality. SUMNER BYRON MYERS: Connexions between differential geometry and topology. A. G. MARSHAK: The sensitive-volume of the meiotic chromonemata of *Gasteria* as determined by irradiation with X-rays. The inflorescence of *Gasteria* provides a regular sequence of buds, so that the effect of irradiation can be determined at various periods after exposure. The frequency of effects are proportional to dosage of radiation. Using Glocker's equation for the number of photo-electrons traversing a given volume, and measuring the volume of the nucleus and bivalent chromosome of *Gasteria*, the observed frequency of induced abnormalities enables the width of the sensitive portion of the half-chromosome to be estimated and eventually that of the single chromatid. The figures obtained agree well with those obtained from the diameters of simple protein molecules. R. E. BOWEN: Movement of sensory hairs in the ear. The author has previously reported movements of hair in the ear of the catfish. Observations are now recorded of regular movements of the sensory hairs in the ears of two marine teleostian fish, the squirrel fish and the striped grunt.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, July 21

BRITISH MUSEUM (NATURAL HISTORY) at 3 and 4.30.—Mr. M. A. Phillips: "British Mammals".

INTERNATIONAL SOCIETY OF EXPERIMENTAL PHONETICS, July 22–26.—Meeting to be held in London. One joint session to be held with the second International Congress of the Phonetic Sciences.

ELECTRODEPOSITION EXHIBITION, at the Science Museum, South Kensington, July 25–October.

July 25, at 3.—Opening by Lord Melchett.

Official Publications Received

Great Britain and Ireland

Poison Gas. Pp. 64. (London: Union of Democratic Control.) 6*d*.

University of London Council for Psychical Investigation. Bulletin 1: Supplement to Short-Title Catalogue of Works on Psychical Research, Alleged Abnormal Phenomena, Spiritualism, Magic, Witchcraft, Legerdemain, Charlatanism and Astrology, from 1472 A.D. to the Present Time. Compiled by Harry Price. Pp. 112. (London: University of London Council for Psychical Investigation.) 2*s*. 6*d*. net.

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1934. Pp. 24. (London: H.M. Stationery Office.) 6*d*. net.

Report on the Phenological Observations in the British Isles from December 1933 to November 1934. By J. Edmund Clark, Ivan D. Margary and C. J. P. Cave (No. 44.) (Quarterly Journal of the Royal Meteorological Society, No. 260, Vol. 61.) Pp. 231–284. (London: Royal Meteorological Society.) 3*s*.

Other Countries

India Meteorological Department. Scientific Notes, Vol. 6, No. 63: Wind Data for Wind Mills. By V. Doraiswamy Iyer. Pp. 57–85+7 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 3*d*.

Smithsonian Miscellaneous Collections. Vol. 93, No. 6: Bar Exostoses. By Aleš Hrdlička. (Publication 3296.) Pp. iv+100+5 plates. Vol. 94, No. 2: Concerning the Badianus Manuscript, an Aztec Herbal, "Codex Barberini, Latin 241" (Vatican Library). By Emily Walcott Emmart. (Publication 3329.) Pp. iii+14+4 plates. Vol. 94, No. 3. Thomas Lincoln Casey and the Casey Collection of Coleoptera. By L. L. Buchanan (Publication 3330.) Pp. iv+15+1 plate. (Washington, D.C.: Smithsonian Institution.)

U.S. Treasury Department: Public Health Service. Time Distribution of Common Colds and its relation to corresponding Weather Conditions. By Mary Gover, Lowell J. Reed and Selwyn D. Collins. (Reprint No. 1634 from the Public Health Reports.) Pp. 14. 5 cents. Further Studies on Growth and the Economic Depression: a Comparison of Weight and Weight Increments of Elementary-School Children in 1921–27 and in 1933–34. By Dr. Carroll E. Palmer. (Reprint No. 1660 from the Public Health Reports.) Pp. 17. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of Yale University. Report of the Director of Peabody Museum for the Academic Year 1933–1934. Pp. 35. (New Haven, Conn.: Yale University.)

U.S. Department of the Interior: Office of Education. Bulletin, 1934, No. 19: The Problem of Duplication as attacked in certain State Surveys of Higher Education. By John H. McNeely. Pp. v+50. 5 cents. Leaflet No. 45: Federal Grants for Education, 1933–34. By Timon Covert. Pp. 14. 5 cents. Pamphlet No. 61: Per Capita Costs in City Schools, 1933–34. By Lulu Mae Comstock. Pp. 19. 5 cents. (Washington, D.C.: Government Printing Office.)

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Reports of the Institute for Science of Labour. No. 25: General Intelligence Test and its Norm. 1: Standardization of Intelligence Tests for Children, Adolescents and Adults; 2: Mental Development of the Japanese. By Dr. Hôken Kirihara. Pp. 22. 50 sen. No. 26: A Study of the Physical Sport-Types of the Japanese. By Dr. Takatugu Yagi. Pp. 17. 30 sen. No. 27: Experimental Studies on the Day and Night Inversion of Daily Routine. By Dr. Tomoyosi Isikawa. (Supplemental Report to the No. 3 Report.) Pp. 14. 30 sen. No. 28: Rafraichometer, an Instrument for Measuring Atmospheric Cooling Power. By Dr. Syuzô Eda and Dr. Sinzi Katuki. Pp. 9. 25 sen. No. 29: 1. Sex-Ratio in the Population of Japan Proper; 2. The Influence of Industrialism upon the Mortality of Young People and Adults. By Dr. Sinzi Katuki. Pp. 30. 60 sen. No. 30: Adaptation and Revision of Non-Verbal Will-Temperament Test. By Dr. Hoken Kirihara. Pp. 14. 30 sen. (Kurasiki: Institute for Science of Labour.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3430 SATURDAY, JULY 27, 1935 Vol. 136

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Culture and Policy in Basutoland

AMONG the simpler peoples, we are told by members of the functional school of anthropological thought, no element of culture can be studied apart from its social context. This axiom, writ large, is the theme of the report of the Commission* appointed by the Secretary of State for Dominion Affairs to inquire into the financial and economic position of Basutoland, of which Sir Alan Pim was chairman and Mr. S. Milligan, representative in South Africa of the Cotton Growing Corporation, and Mr. H. Lesley Smith were the members (see NATURE, June 22, p. 1028). Throughout the report, it is evident that the members of the Commission were deeply impressed by the interlock of social and cultural conditions with those of the financial and economic position, present and future, and by the complete dependence of the political and social advancement of the community as a whole on a harmonious adjustment between such of them as will tend to conflict when faced with change; and in effect, as their final analysis of the situation, the conclusion is stressed that failure to guide the cultural and ethnic characteristics of the Basuto nation into a path which will open the way for a progressive policy, will lead to complete political and cultural breakdown. Basuto society, as at present organised, according to the Commission, is unable to adjust itself to meet the economic strain.

It is a remarkable symptom of the sensitiveness of the modern world as a whole to the influences affecting any one of its parts in any serious degree, that the economic depression which has crippled the more advanced civilisations has not passed by the backward peoples. Over-production and unemployment find their counterpart in the relatively more primitive communities, though not always recognisable as such when translated into terms of non-European culture. Among the pastoral and semi-pastoral Bantu peoples of Africa, especially in the south of the continent, overstocking of the pastoral lands, made possible by the extra-territorial employment of labour, takes the place of the over-production and maldistribution of commodities, while the social consequences of unemployment find their parallel in the effects of the shortage of cultivable land, which bars an appreciable number of the members of the tribe from full participation in the organisation of the community, owing to the lack of the 'lands', which a man is eligible to hold for cultivation on marriage as an essential concomitant of family life.

It is to be noted, however, that the depression is not entirely responsible for this state of affairs. Rather, it has aggravated a situation which has grown out of certain characteristics of Bantu culture. These tend to give rise to difficulties, which become acute when brought into touch with modern economic conditions, especially the employment of native labour at a remuneration, and the introduction of an effective system of administration, eliminating such checks on over-population and its consequences as warfare and freedom of movement, which mitigated these evils under the old tribal regime.

In all three of the South African Protectorates, the financial and economic outlook is grave. Basutoland, though by no means in such serious straits as Bechuanaland, has almost entirely dissipated its financial reserves, accumulated in a period of prosperity, through the measures of

* Financial and Economic Position of Basutoland: Report of the Commission appointed by the Secretary of State for Dominion Affairs, January, 1935. Pp. viii+225. (London: H.M. Stationery Office, 1935.) 3s. 6d. net.

relief which have been necessitated by the fall in the value of its exports of wool, which now stands at less than a third of what it was a few years ago and will fall still lower, and the effects of a two years' drought. The seriousness of the crisis may be gauged by the fact that not only the holdings of sheep, but also the stocks of cattle, the most essential possession of Bantu culture, have shrunk to one half in this time of distress. This catastrophe, however, is by no means an unmitigated misfortune. It has, to some extent, though not entirely, automatically relieved the over-stocking of the pasture land. A further relief has come with the rains. But neither the rapid recovery of vegetation, notwithstanding the onslaughts of the locust, nor the nearer adjustment of stock to the carrying capacity of the land—possibly temporary and pending the return to individual prosperity—will afford any substantial help towards the solution of the problems of Basutoland's future economic and financial stability. The causes are more deeply rooted.

Basutoland, which is one of the most pleasant, is also in part one of the most thickly populated areas of South Africa. Occupation is, or was, confined almost exclusively to the lowlands, which in the semi-pastoral, semi-agricultural economy of the Basuto are mostly under cultivation. The hill regions are devoted to seasonal grazing. In recent years, however, scattered villages have begun to appear in the uplands, though owing to the consequent reduction of pasture and other evils, these settlements have been forbidden by the Paramount Chief. This veto to a certain extent has been ignored.

In a little less than forty years, the population of Basutoland has more than doubled. It is now estimated to stand at 570,000. This is not entirely a natural increase. There has been a considerable immigration of Tembus from the Union, their accession increasing the prestige of the chief. The Basuto, like a number of other Bantu peoples of South Africa, such as the Matabele, came into independent existence during the troubled times of the beginning of the nineteenth century. Unlike others, however, they were not a single tribe or a homogeneous group, but a congeries of unrelated groups, who gradually came to form a confederation under the Bakwena, or "People of the Crocodile", and were moulded into a nation under the prolonged rule of Moshesh (*reg.* 1815–70). Further, throughout their relations with the whites, they were never subdued, but maintained their independence. These are crucial facts in determining the character of present problems and the method to be adopted in the approach to their solution. The dominance of the Bakwena has by now, for the most part, eliminated the original tribal chiefs, and through the system of 'planting out' the younger sons of chiefs as subordinate chiefs, each with a court, a chief's holding of land, and a revenue dependent on fines, has produced a complicated and ever-increasing system of chiefs and jurisdictions of which the possibilities of abuse are obvious, especially as these petty chiefs have acquired a taste for the luxuries of modern civilisation, such as the motor-car, which their legitimate financial resources scarcely permit them to gratify. One serious defect of the system is that it has gravely affected the security of land-tenure, as the land, which in theory belongs to the Paramount Chief as trustee for his people and is at his disposal, may be required at any time for the settlement of a new chief.

As a result of their past history, both chiefs and people are acutely conscious of their independence, and although the people are by no means satisfied under the multiplicity of chiefs and fully alive to the defects of character and weaknesses of individual chiefs, they are intensely loyal to the chieftainship as an institution. Any change of custom, however advantageous, would meet with serious resistance, if it were held to be an encroachment on their independence or the prerogative of the chief.

Such interference is clearly foreshadowed in the far-reaching recommendations of the Commission. Although administration as such does not come within its province, the members have accepted the position that custom, social organisation and financial and economic stability are so closely interrelated, that if the reforms which they consider essential are to be carried out with financial assistance from outside, administrative changes and cultural modifications are essential which will necessitate a drastic change in what has hitherto been a policy of non-interference in internal affairs—of protection without control.

The three elements in Basuto culture, which thus insistently demand attention—the position and authority of the chief, the holdings of stock and the system of land tenure—are everywhere among the Bantu crucial problems of administration. In Basutoland these elements in culture, operating without check in certain directions, have reinforced the natural tendency of the

country to surface erosion and thereby added to the difficulty of the social and economic situation. This applies more particularly to overstocking and the consequent overgrazing, and to the breaking up of the upland pastures for cultivation, owing to the shortage of 'lands' in the lowlands. The removal of the natural protection of the surface soil by these agencies destroys fertility and leaves the land a prey to weeds. The evil is progressive; and the elements in culture which have aggravated the trouble are, as indicated, equally an obstruction in the way of remedial measures. Even if the country had the requisite financial resources, the essential reorganisation for reform of practice is beyond the competence of existing authority. The policy of non-interference is plainly no longer in the interest of the Basuto nation or its future as an integral part of South Africa.

Of possible alternatives, the Commission favours the introduction of a real and effective system of 'indirect rule', operating through a reformed chieftainship and based upon the intense loyalty of the people to the institution of the chieftainship. Only thus, the Commission holds, will it be possible to put into operation measures to check progressive deterioration in the economy of the Basuto and set them on the way to a return to the prosperity which they enjoyed up to a few years ago.

The report of the Commission is neither concerned with nor mentions the question of the future of the Protectorate in its specific relation to the Union of South Africa. On this aspect the recently published White Paper (see NATURE, July 20, p. 96) has cleared the air by its insistence on the necessity for a breathing space to allow a policy formulated in the interest of the native to come to fruition. Not only does it reaffirm the obligation of the British Government to consult the native population of Basutoland, as well as of the other Protectorates, before steps are taken to effect their transfer to the Union, but also it invites the co-operation of the Union Government in the next few years in a policy which will convince the native population of "a real and generous desire to improve conditions in the Territories".

Minerals and International Security

The Mineral Sanction as an Aid to International Security

By Sir Thomas H. Holland. Pp. 96. (Edinburgh and London: Oliver and Boyd, 1935.) 2*s*. net.

THIS interesting little book appears at an opportune moment. Books on international affairs are indeed numerous, and we have plenty of books on minerals; but minerals in relation to international security, and a thesis that the warlike disposition of an aggressor nation can be and should be held in check by a sanction based on mineral supplies, is a fairly new theme, a consideration of which serves to show how vitally necessary for war purposes, as well as for industrial purposes, mineral supplies really are. So long ago as 1929, Sir Thomas Holland discussed the suggestion in his presidential address at the meeting of the British Association in South Africa.

Minerals indeed, as the very stuff of the earth, are fundamental substances. Man has long used the metals, but not until the industrial era did he begin to develop their specialised uses for the purposes that fill so important a place in modern industry. The utilisation of iron and steel at the present day involves the use of a number of alloy metals, including manganese, chromium, nickel, cobalt, tungsten, molybdenum and vanadium, without access to which the metallurgy of iron as we now know it would not be practicable. Iron and the ferro-alloy metals are essential as munitions of war. So are aluminium, antimony, copper, lead, quicksilver, tin and zinc, and some of the more important non-metals, including fluorspar, graphite, magnesite, mica, petroleum and sulphur. All these minerals are briefly and simply accounted for in Part 3 of this book, in which a short account is given of their importance as war materials.

In Part 2 an account is given of the mineral position in each of the important industrial countries, including the United States, Great Britain, France, Germany, Italy, Japan and Russia, showing with which of the important minerals and metals these countries are well supplied and those in which they are deficient.

The British Empire is well equipped with minerals as a whole, but constituent countries considered separately are seriously deficient. The United States, considered as a geographical unit, is better provided for than any other country as regards war minerals. France, Germany, Italy and Japan each has a long list of war minerals

for supplies of which it is dependent on imports. Russia has large but imperfectly developed resources; and although it is somewhat uncertain how she stands as regards home supplies of many important minerals at present, she has undoubtedly large potentialities.

In an introduction Sir Thomas Holland states his thesis, and in Part 1 he gives an account of the origin and nature of the scheme for mineral sanctions for war conditions. Briefly, the position is that Article XVI of the League of Nations Covenant has proved unworkable. It is therefore suggested that an agreement among the nations to refuse supplies of war minerals to an aggressor would provide a suitable and practicable means of restraining any industrialised power that might wish to resort to war, as war could not be carried on for long without such supplies, and no country is self-contained in this respect.

Sir Thomas claims for this mineral sanction that it can be put into operation immediately, and that it will be so effective that no refractory nation will run the risk of losing by war what might be obtained without, if its cause be just, in the International Court of Justice.

Such is the mineral sanction, about which no doubt much argument is possible. The pressing fact before the world to-day, however, is that war is very much in the air and aggressors are on the move. Whether there be any justification for this aggressiveness leaves unaltered the fact that the world cannot be made safe for civilisation and ordered development unless the policy of settling international disputes by resorting to war be abandoned. There lies, therefore, upon the Governments of the world and on the League of Nations, the big responsibility of exploring fully the possibilities of any suggestions that may be made to secure the desired object of seeking a safe basis for world progress, and for that reason no doubt every attention will be given to the consideration of this mineral sanction in order to ascertain its possibilities as a scheme for preventing wars. Certain it is that the days of cheap mineral supplies, as we have hitherto known them, are numbered; and unless Governments plan hard and co-operatively to secure safe conditions for the world's development, without the hindrances and waste that war involves, industrial civilisation as we know it will go to pieces.

As a clearly and simply written account of the bearing of mineral supplies on the problem of international security, this book deserves to be widely read.

Equivalence of the Sexes

Man and Woman:
a Study of Secondary and Tertiary Sexual Characters. By Havelock Ellis. Eighth edition, revised. Pp. vii+469. (London: William Heinemann (Medical Books), Ltd., 1934.) 10*s*. 6*d*. net.

MR. ELLIS suggests in his preface that this book, first published in 1894, may be thought by some to have no longer a useful purpose to serve, as it is supporting a conception towards which general opinion has been moving, that of "the entire equivalence of the sexes". The movement has not, however, been sufficiently rapid to make anything but desirable the preparation of this new and considerably modified edition, with its impartial and critical survey of observations made in many different parts of the world. These have confirmed the author's original view that "the sexes are perfectly poised in complete equivalence".

Sex, it is now generally held, is settled at the moment of fertilisation. With its determination comes not only a development of the gonad-containing organs and of the external structures connected with their functions, but also an interaction of the various endocrine glands which give rise to the distinctive secondary and tertiary sexual characters.

In some directions undoubted differences in these qualities can be established, but even when they are, it is not easy to arrive at the significance of the facts. Readers who look for evidence as to the superiority or inferiority of one of the sexes over the other may not appreciate this book, as very little support is given to either view. In fact, the fallacies inherent in many arguments that have sustained the extremist partisans are clearly and sometimes amusingly exposed.

In the chapter on the head it is shown that many familiar arguments have to give way before a closer and more critical investigation of the evidence. An entertaining illustration of the fitting of fact to theory is met with in the varying statements as to the relative proportions of the frontal and parietal lobes in the female brain. When the frontal lobes were regarded as the seat of the higher mental qualities, evidence accumulated to show that in the female brain the frontal

lobes were small and the parietal large. When further observation gave the parietal lobes pride of place, corrections were soon forthcoming to show that it was the parietal lobes that were smaller. The female brain is certainly on the average absolutely smaller than the male brain, but proportionately to the general body weight it appears to be relatively larger. As for the differences in shape and size of the skull, the author's final summing up is that "It is open to a man in a Pharisaic mood to thank God that his cranial type is far removed from the infantile. It is equally open to a woman to be thankful that her cranial type does not approach the senile."

The difference in muscular strength, now more or less accurately measured as being in the proportion of three to two as between men and women, seems to have been the basis of wages paid to men and women long ago. Records from Suffolk in 1682 give the wages for haymakers as 5*d.* and 3*d.* a day (with meat and drink) for men and women respectively, though for piece work the pay received was generally the same, so that there was no attempt to underpay women as women.

'Affectability', or the quality of responding readily to psychic or physical stimuli, is said to be more highly developed in women than in men, hence also irritability. The neuro-muscular form of this is, Mr. Ellis thinks, relieved by muscular activities such as dancing. Perhaps in this is seen the reason for the liking many women have for knitting or other forms of handwork. Comparisons of the relative delicacy of the senses give some unexpected results, and consideration of the intellectual and industrial aptitudes also leads to interesting and somewhat unusual conclusions.

There is a wealth of material in this book, so impartially presented that very rarely can a different interpretation of the facts available be suggested. The wisdom, the ripe experience and the humanity of the author are shown throughout the book, which should be widely read. He will carry most of his readers with him in the conclusion that "a cosmic conservatism does not necessarily involve a social conservatism". With regard to changes taking place to-day in the relation of the sexes he says: "An exaggerated anxiety lest natural law be overthrown is misplaced. The world is not so insecurely poised. We may preserve an attitude of entire equanimity in the face of social readjustment." If his scientific attitude of mind towards social conditions could be made to prevail widely, there would be less anxiety and more equity in social life to-day, and the world would be a saner and more tolerant place in which to live.

Physics in Chemistry

Hand- und Jahrbuch der chemischen Physik Herausgegeben von A. Eucken und K. L. Wolf. Band 1, Abschnitt 1: Theorien des Aufbaues der Materie. 1: Die Grundlagen der Quantentheorie. Von H. A. Kramers. Pp. 222. 18 gold marks. Band 6, Abschnitt 2: Elektrische Leitfahigkeit. A: Gase, von W. Hanle; B: Flüssigkeiten und Lösungen, von H. Ulich; C: Nichtmetallische Kristalle, von W. Flechsig. Pp. xii+342+18. 32 gold marks. Band 6, Abschnitt 3: Positive Korpuskularstrahlen. A: Verhalten von Alpha-Strahlen bein Durchgang durch Materie, von H. Pose; B: Kanalstrahlen und ihre Wechselwirkung mit Materie (einschliesslich Massenspektroskopie), von R. Wierl. Pp. 284+10. 40 gold marks. Band 9: Die Spektren Entstehung und Zusammenhang mit der Struktur der Materie. Abschnitt 1: Atomspektren. Von H. Kuhn. Pp. vi+266. 26 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.)

THE enormous advances in physics and chemistry in the last few years have rendered it imperative that reliable and readable descriptions of particular aspects of these branches of science should be readily accessible. Consequently, there have recently appeared many treatises on special branches and one or two monumental handbooks dealing with the whole of experimental and theoretical physics. Few of these works, however, attempt to set forth the results of modern physics with what may be termed a chemical bias.

The new "Hand- und Jahrbuch der chemischen Physik", edited by Eucken and Wolf, is an attempt to present the material in a way which makes it appeal more directly to chemists. However, the complete series of important contributions to the literature of physics and physical chemistry which will soon be available, and of which some portions are now under review, will appeal to physicists who wish to study much that is already familiar to them from another point of view.

The first volume, on the theories of the structure of matter, is opened by a very full discussion of the fundamental bases of the quantum theory, contributed by Kramers. Although this rigorous introduction is provided for readers more immediately

concerned with the mathematical aspects of the subject, it must not be assumed that no provision is made for the reader whose mathematical equipment is limited, and a short but fairly complete exposition of the main conceptions and methods of the new quantum theory is provided in Kuhn's book on atomic spectra. Incidentally, the latter also contains a concise introduction to experimental spectroscopy, a very lucid account of spectra and of individual lines, and an unusually clear account of X-ray spectra.

The section by Pose on the passage of α-rays through matter is excellently illustrated, and gives a comprehensive survey of the subject. It will appeal to many who are well acquainted with the excellent English treatises on radioactivity, for it contains much Continental work which is known in England only to the specialist, and the results of experiment are compared with the predictions of modern theory in a very delightful manner.

Hanle's discussion of electrical discharges in gases is remarkable for the way in which the phenomena of the self-maintained discharge are dissected and described, and the inclusion of an extensive treatment of all the problems of ionisation processes in gases. It would seem, however, that the description of experimental determinations of ionic mobilities has been unduly curtailed.

Ulich's section on the conduction of electricity by liquids will be found most helpful by those who wish to learn as quickly as possible the nature of recent developments, for it contains much information which is not readily accessible elsewhere, and at the end of his section he gives a summary of results and indicates the paragraphs where particular pieces of information may be found. Considerable attention is devoted to solvation numbers, and the results of five different methods of measuring hydration numbers are discussed. Flechsig's section on the conduction of electricity by non-metallic crystals is equally interesting.

All the books under notice clearly indicate how important an addition to the literature of science the new venture is likely to prove.

The Foundations of Mathematics

Grundlagen der Mathematik

Band 1. Von D. Hilbert und P. Bernays. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 40.) Pp. xii+471. (Berlin: Julius Springer, 1934.) 37.80 gold marks.

THAT the foundations of mathematics are important is a proposition which will find few opponents, for the science of mathematics is commonly regarded as man's securest intellectual possession. What constitutes these foundations is a subject on which agreement has not been reached. There are, however, three main directions into which the body of modern research has branched, namely, the logistic, the intuitionistic and the formalistic theories. Broadly speaking, the logistic theory regards mathematics as a branch of logic, the intuitionistic theory regards the theorems of mathematics as having actual significance, the formalistic theory regards mathematics as devoid of meaning *per se*. The most powerful exponent of the formalistic attitude is Hilbert, and the present volume is the first part of a systematic exposition of mathematical foundations from the point of view of the school of thought which he has founded. This is probably the most important book on mathematical foundations which has appeared since Whitehead and Russell's "Principia Mathematica".

Hilbert gives the name *Beweistheorie* or 'theory of demonstrations' to his method. The term 'Metamathematics' is also used. The fundamental ideas of the *Beweistheorie* are the following.

(1) The subject matter of mathematics consists of concrete symbols (*Zeichen*) which are immediately recognisable, in fact, the marks on paper which the mathematician habitually uses.

(2) The theorems of mathematics are replaced by formulæ by means of the logical symbols

$$\rightarrow \;,\; \& \;,\; \vee \;,\; - \;,\; (x) \;,\; (Ex)$$
(implies) (and) (or) (not) (all) (some).

(3) Certain formulæ are set up as axioms.

(4) A demonstration is a 'figure' consisting of inferences made by means of the inference scheme

$$\frac{\begin{array}{c}\mathfrak{S} \\ \mathfrak{S} \rightarrow \mathfrak{T}\end{array}}{\mathfrak{T}}$$

where each of the premisses $\mathfrak{S}$, $\mathfrak{S} \rightarrow \mathfrak{T}$, must arise (if necessary by substitution) from an axiom or the end-formula of a demonstration.

Axioms and end-formulæ of demonstrations are called 'demonstrable formulæ'.

The procedure just outlined leads to a purely formal mathematics, which contains formal rules of demonstration but is incapable of making significant logical inferences. In particular, that a formula which has the form of a contradiction cannot arise among demonstrable formulæ is incapable of formal proof since formal mathematics does not contain such a significant proposition. That a system of axioms should not lead to contradiction is, however, an essential point, and it is here that the essence of the *Beweistheorie* lies. Hilbert therefore adjoins:

(5) Parallel to mathematics we have metamathematics, which allows significant judgments on mathematics. Such judgments must be intuitive (*anschaulich*), directly evident inferences such as $1 = 1$.

The application of this principle to the proof that a given system of axioms cannot lead to contradiction is as follows. Let P denote the property that each demonstrable formula has *not* the form

$$\mathfrak{A} \ \& \ \overline{\mathfrak{A}}.$$

It must first be proved in full finite detail that each axiom has the property P. It must then be proved that the application of the rules of inference (4) does not destroy the property P. This proof must also be so devised that it can be carried out in full finite detail in every particular case. Assuming that this can be done, it follows that the given system of axioms cannot lead to contradiction. This is, in fact, equivalent to the proof that $1 \neq 1$ cannot be the end-formula of a demonstration. For certain systems of axioms the proof is completely carried out in this volume. Hilbert is convinced that it will ultimately be possible to carry out the proof for a set of axioms on which the whole of analysis can firmly rest.

It cannot be denied that the *Beweistheorie* has serious critics. In fact the publication of the first volume was delayed, and a second volume was required, on account of certain results of Gödel which seemed to point to the impossibility of carrying out the full programme. Another serious difficulty is the meaning of words, which necessitated the recasting of the chapter on the *Aussagenkalkul* to avoid an interpretation put by Scholz on this subject in Hilbert and Ackermann's "Grundzüge der theoretischen Logik", an interpretation other than that intended by the authors.

Nevertheless, the *Beweistheorie* has cleared the ground in many fundamental problems, has produced sharp formulations of some aspects, and has suggested means of tackling the problems thus raised. Even if one were seriously to entertain the idea that Hilbert has reduced mathematics to a game, it would have to be admitted that the game is certainly not an easy one. Perhaps one quotation may be allowed.

"Die Methoden der Analysis sind in einem Ausmass erprobt, wie wohl sonst kaum eine wissenschaftliche Voraussetzung, und sie haben sich aufs glänzendste bewahrt. Wenn wir diese Methoden unter dem Gesichtspunkt der Evidenz kritisieren, so entsteht für uns die Aufgabe, den Grund für ihre Anwendbarkeit aufzuspüren, so wie wir es überall in der Mathematik tun, wo ein erfolgreiches Verfahren auf Grund von Vorstellungen geübt wird, die an Evidenz zu wünschen übriglassen."

L. M. MILNE-THOMSON.

The Electronic Structure and Properties of Matter: an Introductory Study of certain Properties of Matter in the Light of Atomic Numbers. Being Vol. 1 of "A Comprehensive Treatise of Atomic and Molecular Structure". By C. H. Douglas Clark. Pp. xxvi + 374. (London: Chapman and Hall, Ltd., 1934.) 21*s*. net.

THIS book, written by a chemist for chemists, sets out to review recent progress in atomic and molecular theory and to correlate various properties of matter such as cohesion in terms of the electronic structure of atoms. The first section is devoted mainly to a description of the quantum numbers of electrons in atoms, the principles underlying the electronic structure of atoms and the characteristic features of the Periodic Table. The quantum numbers used in the old orbit theory are described in some detail and then a brief account is given of the modifications found necessary in the new quantum mechanics.

This historical method of approach has its disadvantages, for it necessitates the description of symbols which are afterwards discarded. The description of modern quantum numbers is brief, and there is little indication of the interpretation which can be given to them, so that the reader will have no option but to memorise the list of symbols given. Once the quantum numbers are dealt with, the author proceeds more happily to the discussion of the electronic structure of the transition elements and the rare earths and the explanation of some of their characteristic properties. In the second section of the book, methods are discussed of determining the sizes of atoms, ions and molecules, electric and magnetic properties of the elements and the various types of cohesive forces.

The treatment is light rather than profound, and is apt to be sketchy, and to convey the impression of a series of abstracts of papers. None the less, the book provides an easy introduction to a subject which is likely to become of increasing interest to chemists and is not easily accessible elsewhere. Doubtless many will be stimulated by this broad survey to pursue the subject further, and they will be helped to do so by the excellent list of references at the end of each chapter, a feature which adds considerably to the value of the book.

Das Giftbuch des Śanāq: eine Literaturgeschichtliche Untersuchung

Von Bettina Strauss. (Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin, Fortsetzung des Archivs fur Geschichte der Mathematik, der Naturwissenschaften und der Technik, Herausgegeben vom Institut fur Geschichte der Medizin und der Naturwissenschaften, Band 4, Heft 2.) Pp. 64+66. (Berlin: Julius Springer, 1934.) 15 gold marks.

THIS book contains the Arabic text, with an annotated German translation, of the "Book of Poisons" of Śānāq, that is, Cāṇakya (Chanakya), the minister of King Chandragupta (fourth century B.C.). The Arabic version is not a direct translation of an Indian original, but is rather a compilation from both Indian and Greek sources. It was apparently based on a Persian translation of an Indian "Poison-book of Chanakya" made by an Indian physician, Mankah, of the celebrated hospital at Jundi-Shapur. Mankah also translated other Indian medical books, such as a treatise on the names of drugs, and a medical compendium of Susruta. The Arabic version of the "Poison-book" was made from the Persian by one Abū Ḥātim of Balkh, about whom we have no information. It was later re-edited by Al-'Abbās ibn Sa'īd al-Jauharī, who was probably responsible for the introduction of the Greek material.

The book gives a useful picture of early Muslim pharmacology, in which much shrewd and careful observation was diluted with at least as much matter of an unreliable and fanciful character. The Arabic text has been well established and is clearly printed, while the German translation follows the original with close accuracy. It is, however, a great pity that no index of any kind is provided. E. J. H.

Kleine Meteoritenkunde

Von Prof. Fritz Heide. (Verständliche Wissenschaft, Band 23.) Pp. vi+120. (Berlin: Julius Springer, 1934.) 4.80 gold marks.

THE discussion of meteorites in this handy little volume commences with their entry into our atmosphere; the cosmogonical interest has to be found by working back from the chemical analysis of their contents. Even the geophysical phenomena relative to the falls of meteors—the information that they have given as to the highest regions of the atmosphere—are omitted from this book, which is strictly limited to the meteorites that fall to earth. Very full details of these, however, are given and much useful information for the geophysical chemist and mineralogist. The introductory historical chapter is extremely interesting. The number of large crater-fields of meteoritic origin will surprise most readers who come newly to the subject, but it is reassuring to find that there is no certain evidence of any person having been killed by a falling meteorite. Photographs of the devastated country in Siberia surrounding the scene of the great fall of July 30, 1908, show what damage can be done and leave one thankful that so far no densely populated country has been visited by a giant meteorite.

Geologie Südamerikas

Von Prof. Dr. H. Gerth. (Geologie der Erde, herausgegeben von E. Krenkel.) Teil 1. Pp. vii+199+17 plates. (Berlin: Gebruder Borntraeger, 1932.) 22 gold marks.

THIS volume is one of the series of monographs on the regional geology of the earth published under the general editorship of Prof. Krenkel, and deals with the South American continent from the Pre-Cambrian up to the end of the Palæozoic.

The aim of the author has been to provide, not a detailed regional description but a comprehensive general introduction to South American geology and its problems. At the same time the needs of the reader requiring more precise and detailed information on any particular area or subject have not been lost sight of and each section of the book is provided with an extended bibliography.

Approximately half the book is devoted to a consideration of the Pre-Cambrian basement of the continent, and the structural, petrological and tectonic problems are dealt with rather fully. This is by no means excessive in view of the structural importance of the Pre-Cambrian in South America. Each region is considered separately and then the continent as a whole is dealt with in a concluding section. Much the same method of treatment is adopted throughout the remaining chapters on the Palæozoic systems, and the volume concludes with a chapter on the so-called 'Gondwanides'.

The author has brought together a great mass of information from scattered and often inaccessible sources, and has provided a most useful, up-to-date and well illustrated treatise on South American geology.

Dix leçons d'astronomie

Par Ernest Esclangon. Deuxième édition revue et corrigée. Pp. 116+20 plates. (Paris: Gauthier-Villars, 1934.) 25 francs.

IN this volume of popular lectures, the director of the Paris Observatory has given as simple and clear an account of modern astronomy as can be given in one hundred pages. The style is extremely lucid, as is to be expected in a French book, the facts are accurately given and up-to-date, the illustrations are numerous and the whole volume is very pleasantly readable. In addition to the definitely astronomical chapters, there are two which will be read with much sympathy and interest. The opening chapter gives an account of the importance of astronomy in the past in the development of thought and of civilisation; the final chapter, after dwelling upon the glories of French astronomy in the nineteenth century, emphasises the reasons why France has of late dropped out of a leading position in astronomical research. Modern developments require large instruments, and so far the money has not been forthcoming from Government or private sources to keep France abreast of most other countries. It is to be hoped that Prof. Esclangon's appeal in this volume may fall upon fruitful ground—and if fresh developments in France react favourably upon Great Britain, so much the better.

Fifty Years' Progress in Marine and General Engineering

JUBILEE OF THE NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

OF the various industrial districts around the coasts of Great Britain, none has a greater variety of industries than that known as the 'North-East Coast'. Here, situated on the banks of the Tyne, the Wear and the Tees are coal-wharves, ship-yards, engine-shops, steel-works and factories by the score. But the outstanding industries are shipbuilding and marine engineering, and ships built or engined at Wallsend, Elswick, Hebburn, Shields, Sunderland or Hartlepool are found all over the world. As compared with the Thames, the Mersey and the Clyde in the early days of steamships, the district occupied a minor position as a shipbuilding centre. About the middle of last century, however, it began to specialise in the building of economical slow cargo ships, and its success in this direction led to developments which perhaps are as remarkable as they were unexpected. In 1850, the depth at low water over the bar at the mouth of the Tyne was only 6 ft. Now the channel of the river is dredged to more than thirty feet, and into the river have been launched such vessels as the *Mauretania* and H.M.S. *Nelson*. To-day, ships of many classes and marine engines of every type are constructed in the district.

In these circumstances, it was but natural that at the jubilee meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at Armstrong College, Newcastle-upon-Tyne, on July 16–19, the principal papers read should have dealt with the progress of ships and their machinery, while the Citizens' Lecture should be "Ships Through the Ages", this being delivered by Sir Westcott Abell.

The three papers dealing with developments in the construction of ships during the past fifty years were on liners, by Mr. J. D. Christie; on cargo ships and tankers, by Mr. J. McGovern; and on coasters, by Mr. F. W. Dugdale. When dealing with the progress of liners, speakers often confine themselves to the vessels of the North Atlantic, where the largest and fastest ships are found. Mr. Christie, however, took a wider view of his subject and sketched the progress in passengers ships not only on the North Atlantic, but also in ships running between Europe and South America, South Africa, India, Japan and Australia, as well as in those crossing the Pacific. The paper is accompanied by seven useful tables dealing with ships on these various routes. As regards technical problems, he said that, judging by published figures, it does not appear that the latest ships are superior in form to the *Mauretania*, in so far as minimum resistance and propulsive efficiency are concerned. The evidence, too, for the various new forms of bow are conflicting. There is no question of the value of the new tensile steels and of the introduction of welding, while the question of watertight subdivision appears to have reached a certain degree of finality. A great desideratum is the lessening of vibration and the reduction of pitching and rolling, but nothing has yet appeared to show that the Sperry anti-rolling gyroscopes in the *Conte de Savoia* have justified the great cost entailed. In no direction does the passenger liner of to-day present a more marked contrast to the ships of 1885 than in the arrangements for the comfort, safety and enjoyment of passengers.

The carriage of coal, grain, ore, timber, oil, sulphuric acid, molasses and such cargoes present different problems to the naval architect, and in his paper entitled "Cargo Ship and Tanker Development", Mr. J. McGovern described the various types of cargo vessels and their main structural features. The ways in which the plating of a ship may be held together and supported by the internal framing are endless. Special designs of ships developed on the North-East Coast have been the 'Turret' vessels of Doxford's, the 'Trunk' vessels built at Stockton and the Priestman 'Self-Trimmer' type built at Sunderland. One of the landmarks in ship construction was the introduction in 1906 by Sir Joseph Isherwood of the longitudinal system, giving increased strength with less weight of steel. To him also is due the recent radical departure from the orthodox box form of section designated the 'Arcform', wherein he has adopted a midship section shape entirely dispensing with the square bilge long familiar. Extensive model experiments and actual voyage performances of three 'Arcform' vessels have proved them to be the most economical cargo-carrying vessels of their class afloat to-day.

It is acknowledged by all that while many improvements in the structural details of ships have been made during the past fifty years, the improvements in machinery have been still more striking. Half a century ago, the majority of vessels were driven by compound engines using steam at comparatively low pressure. Coal

consumption was high, boilers were heavy, marine auxiliaries were unsatisfactory; the water-tube boiler was in its infancy, oil burning at sea was unknown and the marine steam turbine undreamt of except by Parsons. The triple expansion engine, however, was fast making ground, steel was being used for boilers, forced draught was being introduced, engines were getting more powerful and an era of rapid development was setting in. At the jubilee meeting of the North-East Coast Institution four papers on marine engineering touched upon these matters, and briefly described some of the latest innovations. The paper on turbines was by Mr. R. J. Walker, that on reciprocating steam engines by Mr. S. Hunter, Junr., that on boilers by Mr. T. McPherson and that on marine heavy-oil engines by Mr. H. O. Keller. Like the papers on ships, these are all well-illustrated and together constitute a brief but valuable record of achievements to which scores of men of many countries have contributed.

The last paper read, entitled "Recent Developments in Electrical and General Engineering", was by Mr. M. G. S. Swallow. The 'North-East Coast' engineers have a right to be proud of the work done by what to-day is the North-Eastern Electric Supply Co., which Mr. Swallow says "was the prototype of the present interlinked electric supply system of the country". But of more interest than the technical information given in this paper were the stimulating remarks on 'North-East Coast' engineering generally. "The history of our Institution," he said, "is a record of men who have led and achieved in the past. . . . To-day the inventive ability, the scientific knowledge, the tenacity and skill which have made us successful are still ours. Some of our industries may decline temporarily or may be lost to us. But this is no reason for despair or lament. Engineering is not only progressive, but is for ever conquering new fields and our activities spread and continually increase." This undoubtedly is the right outlook for a district which has been rendered famous by the labours of the Stephensons, the Hawthorns, Palmer, Armstrong, Rendel, Morison, Tweedy, Marshall, Noble, Doxford, Laing, Parsons and many other great engineers.

The Economic Importance of the Foraminifera

By Dr. H. Dighton Thomas, Department of Geology, British Museum (Natural History)

PERHAPS the application of science to industry provides no romance equal to that of the smaller Foraminifera. Those earlier research workers, Carpenter, Brady and others, could have had no inkling of the importance that that class of lowly-organised animals was to achieve in the exploitation of oil in various parts of the world.

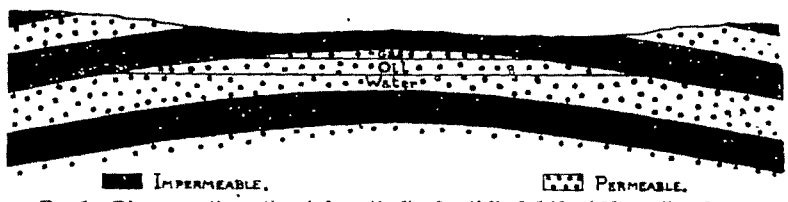

FIG. 1. Diagrammatic section (schematised) of anticlinal fold yielding oil and gas.

It is the object of this article to explain in outline the way in which the Foraminifera are of use economically.

The winning of oil from the reservoir rocks (other than those oil-shales which yield it on distillation) depends very largely on the correct identification of the tectonic structure of the petroliferous areas and the exact location of the fold-axes and fault-lines: for in many fields there is a very close relation between the geological structure of the area and the sites of the oil accumulation. Thus, anticlinal folds (Fig. 1) frequently act as the reservoirs, the oil, possibly associated with gas, occurring in a permeable stratum at some depth below the surface, and overlain by impermeable beds which act as a cover. Accurate geological mapping provides the solution of the problem of the tectonic structure, but, as with all such mapping, it is dependent on the correct stratigraphical identification of the rocks.

Although petroleum is yielded by rocks of almost all ages, attention here will be focused on oil-bearing Cretaceous and Tertiary rocks. Many of these beds are often, but not always, rich in small Foraminifera, though other fossils are present also. Although the latter are not neglected by the palæontologists now attached to most oil companies, yet the Foraminifera have received particular attention, both because they often occur in great numbers in small samples of the rocks, for example, shallow auger-borings, and because

of their frequently widespread distribution. It has been shown from this study that in many oil-fields the Foraminifera, properly used, are excellent stratigraphical markers. Naturally, the methods have been applied to the older fossiliferous formations also, but, even where small Foraminifera are relatively abundant, as in some parts of the Carboniferous, opinions are divided as to their usefulness there. But there are no two opinions on the value of the Cretaceous and Tertiary Foraminifera.

In the technical application of the study of this order of the Protozoa, one of the fundamental considerations is that, for a given period, basins of deposition or embayments may be recognised, and that over a large part of each basin the conditions of sedimentation are similar. In the geological history of such a basin (excluding its margins where facies changes, that is, of lithology*, take place) the changes affecting it usually occur contemporaneously all over the basin, so that the stratigraphical sequence is usually constant throughout it, but different from that of neighbouring basins. These have different geological histories and experience different changes, so that each basin has to be studied separately. In addition, where lateral changes of facies occur, due for example to the approach to shore-line conditions, those areas also have to be treated separately.

The foraminiferal fauna of any area of deposition at any given time is related to the conditions then prevailing, so that the changes affecting the area (changes of salinity, depth, temperature, nature of the sea-bottom, etc.) result in changes in that fauna. Thus, in such a basin there is usually found, throughout all but those parts where lateral facies changes occur, a definite sequence of foraminiferal faunas. Some species, although their geological range considered throughout the world is very long, may be restricted to a small thickness, or to one layer in such an area; others may be very common at one horizon, be absent at another, and then reappear (as conditions changed again) either as a common or a rare form.

Thus the relative abundance of a species at a given horizon, as well as its presence, is a point of great importance. In this way, either by the determination of those species which are found to be restricted to definite horizons, or by the faunal assemblages themselves, the Foraminifera have proved in practice to be of great local zonal importance.

This is the more so in those cases where great thicknesses of similar rock types have been laid down over large areas. Thus in some petroliferous regions there are great masses of glauconitic sands and clays, and the determination of horizons and geological structures is not an easy matter without palæontological aid. Moreover, the difficulties are not simplified in those areas where the country is swampy and covered with dense vegetation, so that rock exposures are few. The value of the foraminiferal zones in the unravelling of the geology of these areas is very high, and it is not without importance that the crucial evidence can be obtained from a relatively small amount of the rock.

A standard zonal series for that part of the geological column represented in the area is first established either from a number of natural sections which, when pieced together, give a continuous section, or from artificial sections, such as well-sinkings. A detailed analysis of the foraminiferal fauna of successive levels is made, samples of approximately equal weight being used, so that the relative frequencies of the species may be determined. Permanent records of the species of Foraminifera which have been found, their horizons, and their relative abundance at the various horizons, are then tabulated on charts†, so that the zones can be determined. In this, particular attention is paid to those species which have restricted ranges, to the incoming of species, and to the disappearance of species from the succession (in the latter case, this is equivalent to the incoming of the species in a descending series of samples from a well-sinking). Often the oil palæontologist is not concerned with the scientific names of the species, but instead numbers, or letters and numbers (the combination indicating the locality as well as the species), are allocated to them. Ultimately, however, since inter-regional correlation will become a necessity, the correct scientific identification of the species will have to be made.

After the establishment of this zonal series, its application in the field to the determination of the age of the rock exposures or of core-samples is easily made. In order to facilitate matters, various travelling laboratories have been devised, so that the washing of the clays, and the separating, mounting and identification of the Foraminifera can be made on the spot; or samples—often obtained from shallow auger-borings or small trial diggings—are collected continuously by the field-geologist in a traverse, carefully and accurately labelled, and dispatched as quickly as possible to the palæontologist for investigation. To the field-geologist himself, acquaintance with some distinctive and easily recognisable species is of the greatest use for the preliminary identification of

* As, for example, from limestones to clays and shales.

† See Nuttall, W. L. F., *World Petroleum Congress Preprint No.* 28, 1933

the stratigraphical horizon of a rock seen in a natural or artificial exposure. From the observations and investigations so made, a geological map can be constructed in the usual way, and the geological structure of the region can thus be determined.

Besides this use in mapping and the location of tectonic lines in an area, the Foraminifera are also useful in connexion with the sinking of wells. In boring to the known oil-bearing stratum, samples of the core are taken at frequent and known depth-intervals, and examined for the Foraminifera, so that a continual check is kept on the depth to which the shaft is to be sunk. Such palæontological observations will also indicate quickly when the productive stratum has been passed (for example, in a fault), or when the well is placed too far from the crest of the oil 'trap' so that it will strike water and not oil (see Fig. 1). The saving in expense by the rapid recognition of the futility of further boring on those sites is obvious.

Further, great wastage of oil has occurred in some fields in the past, because 'gushers' have burst out before it was considered necessary for steps to be taken to prevent this loss. But this has been largely obviated by the sampling of the cores, the Foraminifera giving a sure indication of the horizon reached and therefore of the distance above the oil-bearing stratum. In one field, for example, one species makes its appearance (in the descending series) at a relatively short distance above the reservoir rock, so that its recognition in the core-sample gives the indication that the drill has nearly reached the reservoir rock and that precautions must be taken to prevent loss from the oil 'gushing' on further boring.

It will be seen from the above that the smaller Foraminifera can be used to determine the age of the rocks yielding them, and so, by detailed field collecting and investigation, to unravel the geology of an area. When this has been done, then the knowledge so obtained can be used to determine the best sites for drilling for oil, if oil is present in the area. But there is no causal connexion between the Foraminifera and oil—the presence in an area of a given foraminiferal species, or foraminiferal fauna, or foraminiferal zonal series, is no indication of itself that oil is present, though that, however, is a widely-held misconception.

It is knowledge of the detailed geological structure which is of crucial importance in an area known to be petroliferous. But the Foraminifera, if intensively collected and the results from innumerable rock-samples carefully analysed, often supply the key to the problem of the determination of that structure.

A POSTSCRIPT UPON THE "ORIGIN (AND DEVELOPMENT) OF SPECIES"

By Edward Heron-Allen, F.R.S.

In the foregoing article Dr. Dighton Thomas has efficiently dispelled the somewhat widely-spread illusion that Foraminifera, *per se*, especially certain genera and species, indicate the occurrence of mineral oil at a given depth. There are certain ascertained phenomena which indicate the presence of oil in a district, and it is when the 'show' has been observed and noted, that the importance of the Foraminifera to the 'petroleum geologist' becomes apparent. A word of warning to the young geologist, who has now become a necessary official attached to every petroleum company of any importance, should perhaps be added: Let him firmly ignore what Earland has rightly called "the spate of literature" and I have called "the proliferation of nomenclature". The industrious Dr. Hans E. Thalmann has recorded three hundred and eight papers on the Foraminifera published in the years 1931 and 1932, and to these may be added scores of later papers noted in the "Zoological Record" and in the lists periodically published by Dr. Cushman since that date.

What may be called 'the Commercialisation of Protozoology' has, however, had one beneficial effect—a blessing in a deplorable disguise—and that is that there would have been as many papers again published, were it not that the Foraminiferal fauna of a given district have risen—or fallen—to the rank of a trade-secret, and many oil companies jealously guard their zoological records (and even specimens of material from their bores) from the prying eyes of rivals in the trade.

The shattering fact has already been recorded in these pages*, that of recent years the number of genera forced upon protozoology amounts to five hundred and fifty-eight (not counting sub-genera), whilst as regards species the brain simply reels. It is not humanly possible to keep track of them, but anyone who pays any attention to the literature of Foraminifera gradually realises that professional rivalry has something to do with it. Profs. A, B and C are the recognised authorities of as many rival schools of foraminiferal research, which appear to race one another in the recording of new species (and even genera) and each school is ready to swoop, vulture-like, upon the announced discoveries of its rivals, and to pick them to pieces, fondly imagining that students will collect for themselves a new working nomenclature out of the *disjecta membra* left after their attacks upon one another.

I enjoy being 'howled down' by the spokesmen of the advanced schools of petroleum geologists,

* Heron-Allen, NATURE, 134, 43, July 14, 1934.

and I continue to advise the young men, who recurrently visit our collections at the Natural History Museum, to revert boldly to the bygone nomenclatures (condemned by some) of the great *scientific* Foraminiferists, who died in peaceful ignorance of the pending effects of commerce upon their study—Parker, Jones, Brady, Millett, Williamson in our country; d'Orbigny, Berthelin, Schlumberger, Terquem in France; Haeusler, Karrer, Reuss, Schultze in Germany; Costa, Fornasini, Seguenza in Italy—to mention only the names which spring to the memory at once.

The works of these giants will tell them all they need to know. Let them fix this sound *corpus* of genera in their minds, and distinguish the variations of species by numbers, each for himself, species that they will recognise as their own old friends in every district which they have to examine and report upon.

When their work has been done and borne fruit in the form of adequate remuneration, let them if they like—and are allowed by their board of directors to do so—hand their 'mounts' on to the pupils of Profs. A, B and C, and let them fight it out. *They* need not bother about it any more—taking the Omarian advice of the late Aurelius D. Godley:

"The moving Finger writes; then, having writ,
The Product of your Scholarship and Wit
Deposit in the proper Pigeonhole—
And thank your Stars that there's an End of It."

Obituary

Prof. Hugo de Vries, For.Mem.R.S.

BY the death of Hugo de Vries, on May 20, at the age of eighty-seven years, biology has lost one of its outstanding figures in the history of the last century. He proved himself a master of plant physiology in the period 1870–85 when that science may be said to have had its modern beginnings; but the problems of evolution held his attention from the time when, as an undergraduate at Leyden, he read a German translation of the "Origin of Species". The transition from experimental physiology to evolutionary theory took place with the publication of his "Intracellular Pangenesis" in 1889, but his earlier work no doubt made it easy for him to introduce experimental methods into the investigation of evolutionary problems.

The range of de Vries's early physiological researches may be indicated by series of papers on such topics as the permeability of protoplasm, the movements of climbing plants, contractile roots, the germination and growth of such crop plants as red clover, potatoes and sugar beets, the reactions of *Spirogyra* and *Drosera*. A series of investigations on food plants were done for the Prussian Ministry of Agriculture while a student with Sachs at Wurzburg.

In his classical researches on the mechanical causes of cell stretching in plants (1877), de Vries introduced the plasmolytic method, determining the osmotic pressures of cells and developing the conception of isotonic coefficients. In 1884, by comparing the plasmolytic effects of many isosmotic solutions, he was able to show that the osmotic pressure depends on the number of molecules in solution. He also used these methods to determine the molecular weight of raffinose. This work formed the basis for the laws of dissociation in dilute solutions, with which the names of the physical chemists Van 't Hoff and Arrhenius are connected.

The intracellular pangenesis was an important development of Darwin's earlier theory of pangenesis. In it de Vries related theories of heredity and development to the increasing knowledge of cells, and put forward the view which modern work has proved to be correct, that every nucleus of the organism contains a full representation of the hereditary materials. In that work is clearly stated the conclusion that "hereditary qualities are independent units, from the numerous and various groupings of which specific characters originate", and for these units he adopted the term 'pangen'. This anticipation of the modern theory of the gene in all its essentials was a masterly triumph of clear thinking—especially when we remember its date, 1889.

In the same work de Vries criticised the views of Weismann, especially as regards his theory of the idioplasm and his idea that a sorting out of germinal materials takes place in different types of somatic nuclei. The influence of these erroneous views would have been avoided had contemporary zoologists been able to recognise that Weismann's elaborate architecture of the germplasm held less truth than de Vries's simpler but better founded theory. The two authors agreed, however, in denying the inheritance of acquired characters.

In the same year (1889) the publications with what we would now call a genetical bearing were begun, with papers on sterile maize plants and on the inheritance of twisted stems. This was followed during the next decade by a stream of papers on similar subjects. From now onwards, heredity and variation claimed the whole of de Vries's interest, yet the problems were viewed from the first with an experimental background.

The turn of the century marked the well-known triple rediscovery of Mendel's principle of segregation in hybrids, which de Vries had confirmed in several plants before publishing his account in 1900. In the meantime, in searching for mutable plants in accordance with his theoretical views, he had begun so early as 1886 the cultivation of *Œnothera Lamarckiana* and the investigation of its variability. His first paper on *Œnothera* appears to have been in 1895, on the introduction of *Œ. Lamarckiana* into the Low Countries. The "Mutation Theory", first published in 1901–3, and afterwards translated into English, will remain a classic as the earliest example of the pedigree method applied to evolutionary problems, and as a statement of the broad biological distinction between mutations and fluctuations which has gained general acceptance in modern biology. It may safely be said that no work since the "Origin of Species" has had so profound an effect on evolutionary thought. The early years of this century were epoch-making, and progress has gone on with increasing rapidity since de Vries and Bateson led the way with the conception of discontinuity, or better, definiteness in variation.

Œnothera became classical material for the investigation of the more complicated problems of genetics and cytology. No other genus of plants has been subjected to such prolonged and extensive genetical investigations. By 1915 the mutations had been analysed in terms of change in chromosome numbers. The succeeding twenty years has disclosed new conditions in the genus, many species have been recognised as heterozygous, with two complexes yet breeding true owing to balanced lethals and fixed chromosome catenations. While the mass of evidence has necessitated many developments and re-orientations in points of view, yet the general conception of mutation which de Vries founded has remained the basis of genetical work, although views still differ as to the value to be attached to mutations as the raw materials of evolution.

De Vries continued his breeding work with evening primroses until the end. In 1909 was published "Species and Varieties: their Origin by Mutation", as a result of an American lecture tour, and in 1913 "Gruppenweise Artbildung", which is entirely devoted to analytical breeding experiments with *Œnothera*. In 1918–20 six volumes of his collected early papers were published, a seventh volume, of *Œnothera* papers (1915–25), being added in 1927.

De Vries was born in Haarlem on February 16, 1848, the son of a former Prime Minister of Holland. After study in various German universities, he occupied the chair of botany at Amsterdam from about 1878 to 1918, and was not tempted away by flattering offers from Berlin, Columbia and other universities. In Holland his name became a household word and in scientific circles his fame spread throughout the world. When he retired at seventy years of age, he went to live in the village of Lunteren. Here he continued his experiments with evening primroses in a private garden and laboratory attached to his residence. Among the numerous scientific honours conferred upon him was the foreign membership of the Royal Society (1905), the Darwin Medal of the Royal Society (1906), and the gold medal of the Linnean Society (1929).

The genius of Hugo de Vries resulted from the combination of an acute, sagacious and clear-reasoning mind with a power of accurate observation which is rarely equalled. Every biologist would gain from a re-reading of "Intracellular Pangenesis", which was translated into English in 1910. It shows how unerringly his reasoning from the few known facts guided him to views which require extraordinarily little alteration in the light of modern detailed knowledge.

R. RUGGLES GATES.

Miss Ida M. Roper

MISS I. M. ROPER, who died at a nursing home in Bristol on June 8, in her seventieth year, was known widely for her devoted work as a field botanist, and as a contributor of well selected dried specimens to both the British Botanical Exchange Clubs. She had been honorary secretary and librarian of the Bristol Naturalists' Society for nineteen years, and was the only woman to become president (1913–16); also the first woman to serve on the Council of the Bristol and Gloucestershire Archæological Society. Her presidential address on mistletoe showed wide research on the host trees of that parasite; and her second annual address was appropriately entitled "Some Historical Associations of Flowers". Her power of organisation was remarkable. In 1920 she joined the Somersetshire Archæological and Natural History Society, and was also a useful committee member of the Botanical Section.

Miss Roper gave great help to the late J. W. White in the compilation of his excellent "Flora of Bristol", 1912, "not only for field work, but for assistance in literary research and in revision and correction for the press". More remarkable is the fact that for thirteen years she made the collecting and exhibition of local wild plants at the Bristol Museum and Art Gallery a labour of love, both in summer and winter. Her own herbarium of British Phanerogams and ferns, good and beautifully arranged, was recently given to the University of Leeds.

Miss Roper had a particularly good knowledge of British violets. Mosses also interested her, and the British Bryological Society excursions were among the numerous scientific or antiquarian meetings which she enjoyed attending. These included many British Association meetings; hence her cheerful and energetic personality was known to many.

In 1928 Miss Roper rediscovered *Erodium Ballii* in Ireland. Jordan had named it in 1852 from Irish specimens gathered by John Ball, F.R.S. In 1920 she found *Euphorbia platyphyllos* at Keynsham, near Bristol, Ray having noticed it in 1670 as a first record for Britain. Other notes and short articles on British flowering plants appeared in the *Journal of Botany* and in the *Proceedings of the Bristol Naturalists' Society*.

During most of her life, Miss Roper had been interested in monumental effigies, and had visited nearly every church in Gloucestershire and Bristol and many in Somerset to collect information. This culminated in 1930 in the publication of a handsome volume on "Monumental Effigies of Gloucestershire and Bristol". H. S. T.

WE regret to announce the following deaths:

Dr. Arthur Bramley, head of the Department of Pure and Applied Science at Loughborough College, on July 19, aged fifty-six years.

Sir John MacFarland, Chancellor of the University of Melbourne since 1918, a member of the Royal Commission (1899) on Technical Education, Victoria, and of the Government Board (1908) for the Protection of Aborigines, on July 22, aged eighty-four years.

Mr. L. M. Nesbitt, who was awarded the Murchison Grant in 1931 of the Royal Geographical Society for "his difficult journey through the Danakil country of Abyssinia", on July 20, as the result of an aeroplane disaster near the San Bernino Pass, Switzerland.

Sir James Watt, a well-known stock-breeder and forester, formerly chairman of the Forest Tree Growers under the Forestry Commission, on July 1, aged ninety-three years.

News and Views

International Folk Dance Conference

IN another column of this issue of NATURE (see p. 154) there appears a brief account of the conference, which formed part of the International Folk Dance Festival held in London last week. Lack of space for fuller reference does less than justice to a kaleidoscopic spectacle, of which the interest to students of the development of social custom and religious belief, more particularly in Europe, was profound. In its general results, the conference on the scientific aspect of the folk dance has made a very appreciable contribution to the advancement of this branch of the study of the art and life of the 'primitive' element in European populations, both of to-day and in the past. In its effect on future development, it should stimulate the application of that study to the revival and extension of the practice of folk dancing, as well as, possibly, lead to restoration of forgotten or neglected elements where traditional dances and customs are still a living factor in peasant life, as has already happened in certain of the dances which appeared at the festival. On the other hand, the references of many speakers to the obsolescence of traditional customs and dances among the folk and the contrast in the spirit of such dances as those of eastern Europe—for example, the hobby horse dance of the Calušari from Rumania—when the dance is a living functioning element, integral in rural life, argues that the folk dance as a revived art can become a factor in communal life once more only as an attenuated and, to a considerable degree, sophisticated form of expression. Its essential meaning vanishes with the fading away of its economic and magical background.

African Problems

SIR MALCOLM HAILEY, lately Governor of the United Provinces, India, and now director of the African Research Survey, accompanied by Mr. Donald Malcolm, formerly of East Africa, will leave England on August 15 for the purpose of a prolonged journey of investigation on the African continent. During an absence which is expected to extend over a period of eight or nine months, Sir Malcolm Hailey will be engaged in testing and amplifying material which has been collected for a survey of African problems in a report to be published, if possible, in 1937. The survey has been undertaken by a Committee, of which Lord Lothian is chairman, as the result of a suggestion, made by General Smuts in his Rhodes lecture at Oxford in 1929, that it was time to consider how far the resources of modern knowledge were being applied to the problems of Africa, and how far it was possible to co-ordinate the experience of the different territories. The scope of the survey has been limited to Africa south of the Sahara. It will deal with the problems of each territory in the administrative, economic and scientific fields, and will estimate the character and amount of the material available for their study, as well as suggest the lines on which further research and extended study might prove profitable. The aim of the report will be to state facts rather than to criticise methods and results. Dr. E. B. Worthington, of the Department of Zoology, University of Cambridge, has been engaged for some time in digesting the facts relating to research bearing on Africa in all the physical sciences, and a similar digest is being prepared in the economic field. Funds for the cost of the survey have been provided by the Carnegie Corporation of New York.

Academic Assistance Council

THE second annual report of the Academic Assistance Council, published on July 20, contains a statistical summary of the present position of the 1,300 German university teachers dismissed as 'non-Aryans' or for political reasons. Approximately 650 emigrated from Germany; of these, 287 are already re-established in permanent positions and 336 of the others are being temporarily assisted to continue their research. The importance of organised academic

assistance is shown by the fact that of the 287 scholars who have been re-established, 202 are still within the university world. The Council has played an important part in this work, not only within Great Britain by raising during the past year £24,000 for temporary maintenance grants, but also on an international basis by organising a central information bureau. The Council announces that it hopes to continue its information service as long as possible, although it proposes to end its emergency financial grants by July, 1936. It hopes during the coming year to raise funds to create a limited number of research fellowships to retain in Great Britain the services of some of the most distinguished of the displaced scholars. The need for the continuation of the Council's work is evident. During the past two months, 50 more university teachers have been dismissed in Germany, and, as the report points out, "it is impossible for the exiled scholars to regard return to Germany as a possible alternative to further exile". We hope that the Council will receive sufficient financial support to continue its patient work, for it is making a historic contribution to the cause of free learning. Copies of the report may be obtained free on application to the General Secretary, Academic Assistance Council, Rooms of the Royal Society, Burlington House, London, W.1.

Flight Experiments with Compression-Ignition Engines

THE Air Ministry has ordered a number of "Culverin" 720 horse-power heavy oil engines from Messrs. D. Napier and Son, Ltd. It is understood that these are to be used for complete operational tests in large flying boats. Imperial Airways is also interested in the same problem for civil aircraft, and will doubtless be watching these results. The Napier engine is a horizontal water-cooled engine, built under licence from the German Junkers company. The Bristol Aeroplane Co., Ltd., has also developed a compression-ignition engine of the radial air-cooled type, which has actually gained the world's altitude record for aircraft powered with that type of engine. The Diesel type engine has a definite advantage in long-distance flight owing to its smaller oil consumption, but as it is structurally heavier than the petrol engine this advantage is outweighed on short flights. With modern design and performance of heavier-than-aircraft, there is no gain in using it for a flight of less than about eight hours duration. Another major point in its favour is the lessened risk of fire after a crash. Although the fuel oil used is not non-inflammable, its flash point is much lower than that of petrol, and the risk of ignition from flame or hot parts is less. A minor trouble to be dealt with is the lack of facilities for the distribution of this fuel oil at the present time. The oil distributing companies will need considerable additions to their plant before fuel oil will be available upon as world-wide a scale as is petrol.

Polarising Light Filters

THE Eastman Kodak Company, at the ninth International Congress of Photography recently held in Paris, demonstrated a new kind of light polariser, known as the 'Pola filter'. This is made in sheets and may be used to produce effects similar to those obtained with a Nicol prism. Thus when used in pairs, any desired degree of extinction may be obtained by rotating one filter in relation to the other. In photography alone there are many very useful applications for these filters, such as the elimination of surface reflections from glass windows, water, coloured objects (with consequent increased saturation of the colours), the modulation of blue sky brightness without alteration of hue, etc. The comparative cheapness of these filters, and the possibility of manufacturing them in large sizes, opens up a great vista of applications, in which has been suggested their use to combat headlight glare with motor-cars.

Prehistoric India

A DISCOVERY which, if substantiated, holds out promise of great moment for prehistoric archæology in the Near and Middle East, is announced from India. According to a dispatch from Karachi, which appears in *The Times* of July 19, remains of a city of an earlier date than Mohenjo-daro have been discovered alongside the bed of the Indus River at a site known as Kol Deja or Narujadaro in Khaipur State, Bombay. The discovery was made by Mr. Utam Thakur, a research scholar, in the course of survey work. It is stated that shell and earthenware bangles, decorated images and decorative pottery were found. If further investigation should afford ground for accepting the claim that this material represents an earlier stage of civilisation than that already known from the Indus valley, where the earliest city at Mohenjo-daro is dated at about 3300 B.C., it will have a crucial bearing on the problem of the relations of the early civilisations of Sumeria and India. The authorities of Khaipur State have taken measures for guarding the site, and Mr. Thakur is now engaged in seeking financial aid for carrying out systematic excavation in the coming season.

Equipment of a Photo-Elastic Laboratory

A PAPER of the greatest interest to all who contemplate the design and equipment of a photo-elastic laboratory, and indeed of interest to engineers generally, was read to the Junior Institution of Engineers by Prof. E. G. Coker and appears in full, with many illustrations, in the *Journal* of the Institution of April 1935. It was prepared with the view of giving an outline of the essential requirements of a photo-elastic laboratory when a start is being made from the beginning of things and not merely an adjunct to a larger laboratory already well supplied with much of the experimental apparatus and machinery, which can be utilised for photo-elastic work. For this purpose, the paper opens with a concise statement of the elements of photo-elasticity, a subject which might with advantage be taken up much more widely and at an earlier stage than at present, as the elastic properties of materials are of more or less importance to all engaged in technical

work, though of course in a much greater degree to engineers. By its means a considerable advance has been made in our knowledge of the distribution of stress intensities at discontinuities, where very little exact information was previously available. It is particularly useful in the stress analysis of fusion joints, in which it is, as a rule, a fallacy to assume that stress distributions can be determined by applying elementary methods. In this paper, Dr. Coker takes the connexion of two steel plates in line by means of a V fusion weld as a typical example of the incalculable stresses which can be determined by photo-elastic analysis. He describes the apparatus required and concludes with a description of a detached photo-elastic laboratory made by a small addition to a medium-sized house.

The World's Greatest Highway

THE Inter-American Highway from Alaska and Canada in the north to Chile, the Argentine and Brazil in the south, is now, according to an article in *Roads and Road Construction* of February, having its gaps filled in on the maps and plans of engineers. At present, 4,500 miles of its length are passable by motor-cars in all weathers. The finished sections are in Canada, the United States, Mexico and Panama, and parts of all-weather roads are completed in Alaska, Costa Rica, Salvador, Guatemala, Colombia and Brazil. Highways passable in dry weather cover the greater part of the international highway route. The South American portion of the highway offers a great variety of scenery. There are the jungles of Colombia and Brazil, the sea coasts of Peru and Chile, the magnificent heights of the Andes and the broad expanse of the Argentine pampas. A thousand miles of this highway will be at elevations of 5,000–10,000 ft. The international project is to open up a through route for the highway tourist between North and South America. It will be of special value to citizens of the United States living in the Panama zone. The 250 miles of improved road in Panama have already been largely patronised by the residents of the Canal Zone for recreational travel, and a through highway to the north would be very attractive to them. The Central American section makes it possible to open up large areas for agricultural and commercial development and so promote their economic welfare. At present, access is mainly by steamer to the ports and thence by rail, highway or aeroplane. Pan-American Airways provides a service throughout the length of Central America, paralleling the future line of the Inter-American Highway on the Pacific slope of the divide.

Post Office Publicity

THE present-day policy of the Post Office is based on a recognition of the fact that the Post Office is not only a Government Department, but is also one of the largest businesses in Great Britain. In pursuance of this recognition, recent developments have included the establishment of a Public Relations Department, with an organisation for employing all the most modern methods of publicity at its disposal. An interesting account of the policy being followed by this department is given in a recently published pamphlet entitled, "Post Office Publicity". This pamphlet is the eighth of a series of Post Office Green Papers (London: H.M. Stationery Office. 6*d*. net), previous issues of which have dealt with the air mail service and with various aspects of telegraph and telephone communication. The text of the pamphlet has been adapted from a lecture recently given by Sir Stephen Tallents, Public Relations Officer of the General Post Office, and it is illustrated by a selection of photographs and reproductions of posters and pamphlets already issued by the Post Office. This pamphlet shows how recent advances in the arts of press advertising and exhibition display and the arrival of new forms of communication in films and broadcasting have coincided with the growth of the new need of correctly-balanced publicity. The methods by which the Post Office is pursuing these purposes are clearly described. These include press advertising, the supply of posters of high artistic quality for public display and for use in schools, and the participation in public exhibitions of various kinds, and the temporary leasing of shops in important centres for the display of Post Office activities and equipment. Finally, the G.P.O. Film Unit produces and circulates films which illustrate vividly the great variety of Post Office work.

Canalisation of the Upper Mississippi

AN article in the *Scientific American* of February by Mr. S. G. Roberts describes the important work now being done under the United States Army engineers for the improvement of the navigation of the Upper Mississippi River. Some years back it was considered that a channel six feet deep at low water could be maintained by dredging and contraction works, but this proved to be impracticable. In 1931, therefore, it was decided to canalise the whole length of the river between St. Louis and the 'twin-cities' of Minneapolis and St. Paul, a distance of about 650 miles, so as to give a minimum depth of 9 feet. For this purpose, 27 dams are being built, each having locks 110 feet wide and 600 feet long. The dams are provided with spillways and roller gates suitable for contending with fields or floes of ice, which sometimes attain a thickness of 2 feet. The object of the scheme is to provide for the direct shipment of cargoes from Minneapolis and other places direct to New Orleans by means of flotillas of barges which will carry as much as 14,000 tons, and will be towed through the locks without changing formation. The work was begun about three years ago and is expected to be completed in 1938 at a cost of 124,000,000 dollars. "There is every reason to believe," says Mr. Roberts, "that the work now under way will give to the Mississippi valley a trunk-line water route that will mean to the vast region served by it what the Rhine has long been to Central Europe. From Minneapolis to the sea, the Mississippi has a length of 1,950 miles; and the run from Minneapolis to New Orleans is 1,840 miles.

From the head of navigation on the Rhine to the sea, the distance is 445 miles. Therefore the Mississippi offers a water outlet to a far more extensive region than does the Rhine; and the potential wealth of the American domain is infinitely greater and in some respects more varied."

Cold-Storage Plant in Madrid

WITH the aid of cold-storage plant it is possible to regulate the supply of perishable foodstuffs to a city so that, whatever the season, the supply may be sufficient. A privately owned cold-storage building has been erected in Madrid with this end in view. O. Rhunke gives a description of the plant used in this building in the *Escher-Wyss News* of April. A five-storied building was constructed in the immediate vicinity of the principal markets, with the railway track on one side and the Calle de Toledo on the other. The level of the railway is 23 ft. above the level of the street, so that goods are unloaded from the railway into a chute and delivered into the street from the ground floor. Ten thousand cubic metres are provided for storage for eggs, fruit and fish. The main cooling is by conditioned air with brine-circulated cooling in addition. The temperature and humidity of all the cooling rooms have to be kept within prescribed limits. The used air is cleared out several times every day and ozonising is employed. Special care has to be taken to prevent any interruption of the cooling process taking place. A cooling capacity of thirteen million British thermal units per day is required. It was at first thought that such a spacious building would considerably exceed the needs of the city, but three months after the opening practically all the space was utilised.

East Malling Research Station

THE twenty-second annual report, for the year 1934, of the East Malling Research Station, has just been published (pp. 241. 4*s*. net. May 1935). The Station is maintained by the Kent Incorporated Society for Promoting Experiments in Horticulture, with various grants from the Ministry of Agriculture and Fisheries. A 22-page supplement describes the more administrative side of the Station, and leaves the main volume free to set forth the research findings during the past year. These are, perhaps, even more numerous than usual, for a determined effort has been made to elucidate more fully the problems of insecticides and fungicides. Section 1 of the report describes the experimental farm, and is contributed by Messrs. J. Amos, F. H. Beard, M. H. Moore and A. C. Painter, with a foreword by the director, Mr. R. G. Hatton. Section 2 is a general review of research work, with summaries of papers published during the year. It is compiled by numerous members of the staff. The third section, on preliminary research reports, occupies most of the volume. Truly is the East Malling Research Station justifying its comparison, voiced by H.R.H. the Duke of York, to a standard apple tree, which, once established on good soil, would "continue to flourish and yield excellent fruit".

Farm Machinery

THE favourable reception that attended the publication of the first volume of "Farm and Machine" issued by the Institute for Research in Agricultural Engineering, Oxford, last year, has led to the decision that an annual issue would be justified. Vol. 2, which has recently appeared (2*s*. 6*d*.), contains like its predecessor the report of the Institute for the year under review and also a collection of miscellaneous papers on agricultural engineering. The chief event of the year has been the removal of the Institute into its new quarters in Parks Road, a building well suited for the indoor work and provided with excellent workshop and stores accommodation. The testing of various new types of agricultural machinery naturally takes a prominent place in the work of the Institute, but research on the theoretical side is also carried out, from which important advances have already been made. The titles of some of the miscellaneous articles such as market garden tractors, farm electricity tariffs, the mode of action of mole drains, sugar beet harvesting, implements for regenerating grassland need only be quoted to show that the volume is likely to be of help and interest to a wide section of the farming community.

Rare Developmental Condition in a Boy

A NOTE by Science Service, of Washington, D.C., states that a 'dog-boy' four years old is living in Kharkov, U.S.S.R. His face and body are entirely covered with long blond hair, coarse and a little wavy. The child is otherwise normal mentally and physically except for rickets, which is being treated in the hospital. The relatives are all normal so far as known. This very rare condition is known as hypertrichosis universalis. Some thirty such families have been recorded, most of them from Russia. In certain cases reported from India, the hair was dark. The condition is a developmental defect, in which the prenatal lanugo is not shed. It may be accompanied by faulty teeth and nails. Once the condition has appeared, it is likely to recur in the next generation. An effort should be made to determine whether the family producing this child is related in any way to the previously recorded Russian families.

Bibliography of Seismology

IN a recent issue of NATURE (**135**, 1070; June 29), a brief notice was given of the "Bibliography of Seismology" for the year 1934 prepared by the Dominion Observatory of Ottawa. In that note, it was pointed out that Great Britain is not represented in the list of collaborators. We have received a letter from Dr. F. J. W. Whipple, Kew Observatory, in which he suggests that this omission may be taken to imply that the works of British seismologists are ignored in the Bibliography, and he states that in the last quarterly number there are seven references to such publications. On the other hand, in the United States, there are eleven collaborators, who refer to forty memoirs written in that country. The test as regards completeness is not, however, the actual number of memoirs noticed, so much as the

percentage of the total number published that are entered in the Bibliography, and this percentage obviously depends on the number of contributors. In the absence of collaborators, memoirs are, of course, likely to be overlooked.

World Power Conference

THE annual report for 1934 of the World Power Conference, 36 Kingsway, London, W.C.2, records that the transactions of the Scandinavian meeting held in 1933 have been published in seven volumes. The subjects discussed centre round the power problems of large-scale industry and of land and sea transport. The Chemical Engineering Congress will be held in London on June 22–27, 1936, and will be a sectional meeting of the World Power Conference. After preparatory work extending over seven years, it is hoped that tables of international statistics on a strictly comparative basis will be published this year.

Conference of Empire Survey Officers

THE Third Conference of Empire Survey Officers opened in London on July 23 and will continue in session until August 2. The Conference is not open to the public, but an official report of its proceedings will be published in due course. Representatives of Canada, the Commonwealth of Australia, the Union of South Africa, the Irish Free State, India and Northern Ireland, and of about twenty Colonial dependencies, as well as by representatives of various interested departments, societies and institutions in Great Britain, are attending the Conference. The principal object of these gatherings, of which the two earlier ones were held in 1928 and 1931 respectively, is to afford opportunities for surveyors from overseas to obtain and exchange up-to-date information as to the progress made in survey matters, and for discussions on questions of general interest to surveyors.

IN opening the Empire Survey Conference on July 23, Mr. Malcolm MacDonald, the Secretary of State for the Colonies, expressed his pleasure at being able to welcome at the Conference not only representatives of the various Colonies, Protectorates and Mandated Territories, but also representatives of the majority of the self-governing Dominions, of India, and of Northern Ireland. He referred to some of the subjects to be discussed, such, for example, as trigonometrical and topographical surveying, and various aspects of air survey work. Continuing, Mr. MacDonald said, "Another question which appears on your agenda is that of the co-ordination of African surveys. I need hardly emphasise the importance of this, but I should like to express the hope that this Conference will be able to work out an agreed plan for co-ordination in the future. Closely allied with this is the question of the completion of the Arc of the 30th meridian. The possibility of completing this important work at the earliest possible moment is kept continually in mind." Brigadier MacLeod, the Director General of the Ordnance Survey, who was asked by Mr. MacDonald to preside over the Conference, then thanked the Secretary of State on behalf of the delegates for coming to open the Conference and emphasised the value of periodical Conferences of this nature.

ASLIB

THE twelfth annual conference of the Association of Special Libraries and Information Bureaux is to be held on September 20–23 at St. John's College, Cambridge. According to the preliminary programme, Sir Richard Gregory will deliver his presidential address on September 20 and will speak on the "Interpretation of Science". Mr. J. D. Cowley, director of the University of London School of Librarianship, and others will deal in a symposium with special librarians and their problems, Sir Stephen Gaselee, of the Foreign Office Library, will describe libraries and special sources of information in Government departments, and Mr. B. M. Headicar, of the British Library of Political and Economic Science, will deal with the use of reference books. "What Industry expects from Public Libraries" is the title of a paper by Mr. R. Brightman, of Imperial Chemical Industries, Ltd., while Miss E. W. Parker, of the Mond Nickel Co., Ltd., inquires into the use that industry and commerce make of the public libraries in the London area. Further particulars about the meeting can be obtained from the Secretary, ASLIB, 16 Russell Square, London, W.C.1.

The Third International Congress of Soil Science

SOME four hundred delegates, from twenty-five foreign and twenty British countries, will assemble at Oxford for the Third International Congress of Soil Science on July 30–August 7. The delegates will be welcomed by the Vice-Chancellor of the University at the opening session, and will be entertained by the Government at a dinner in Christ Church Hall on July 31. The meetings have been arranged so that questions of wide interest will be discussed in the mornings at plenary sessions, and more specialised ones in the afternoons at Commission sessions. Sir John Russell will deliver the presidential address on "The Place of Soil Science in Agriculture", and Prof. G. W. Robinson will present a general survey of British soils. The plenary session of Commission IV —Soil Fertility—promises to be of particular interest. Prof. E. A. Mitscherlich will describe the co-operative work developed and organised by him in Germany to test his physiological methods of determining fertility, Prof. R. A. Fisher will outline the principles of his well-known methods of field experimentation as used in England, and Prof. O. de Vries will describe fertility measurements in the tropics with special reference to work in the Netherlands Indies. Other papers likely to attract attention are by Prof. F. Hardy on tropical soil types, by Dr. Brune on the cultivation of moorland, and by Prof. Lowdermilk on the measures now being adopted in the United States for the control of soil erosion. The programme covers the whole field of pure and applied soil science, and includes a number of excursions of both scientific and scenic interest in the neighbourhood of Oxford.

Beit Fellowships for Scientific Research

THE Trustees of the Beit Fellowships have awarded the following fellowships for research at the Imperial

College of Science and Technology, during the academic year 1935–36: Extensions of fellowships already satisfactorily held for one year to:—Dr. J. Bell, for research in fuel technology—"A spectrographic investigation of hydrocarbon combustion"; Dr. H. I. Stonehill, for research in chemistry—"The applicability of the modern theories of strong electrolytes due to Debye, La Mer, Bjerrum, Davies, etc., and the measurement of the E.M.F. of certain cells"; and Mr. J. R. Tillman, for research in physics on "Electron diffraction". New fellowships for one year, renewable for a second year, to:—Mr. R. Walls, of the University of Liverpool, for an investigation of the metamorphic rocks of north-east Scotland, under Prof. P. G. H. Boswell; Mr. E. W. Hewson, of the Mount Allison University, Sackville, Canada, and the University of Toronto, for research in meteorology, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada, under Prof. D. Brunt; Mr. J. E. Carruthers, of Emmanuel College, Cambridge, for the study of primary photochemical processes and oxidation, applied to kinetics of gas reactions in general, under Prof. W. A. Bone.

The Sky in August

MERCURY passes through superior conjunction on August 10, after which date the planet is once more an evening object. Venus attains its greatest brilliance on August 3, the stellar magnitude then being $-4\cdot2$. The planet is now moving towards the sun, and will be difficult to pick up with the naked eye at the end of the month. Mars is still conspicuous in the evening sky, but is decreasing in brilliance, from $+0\cdot6^m$ to $+0\cdot8^m$ during the month. This planet is moving towards Jupiter, and will be in conjunction with it on August 27 at 23h., Mars being 2·2° S. Jupiter is much the brighter of the two, its stellar magnitude declining from $-1\cdot7^m$ to $-1\cdot5^m$ during August. Saturn is now rising before midnight, and will be in opposition to the sun on August 31. The stellar magnitude declines from $-0\cdot02^m$ at the beginning of the month to $0\cdot00^m$ at the end of the month. It is interesting to inquire whether there is any prospect of seeing all five of the naked-eye planets this year. Venus and Saturn make their closest approach in Right Ascension on August 18, when the two planets are 11h. 16m. 37s. apart. On account of their southerly declinations, they will not be simultaneously visible at Greenwich, or at any station north of terrestrial latitude 39° N. Observers at stations south of this limit will be able to see four of the five naked-eye planets at the same time. Venus goes off as Mercury comes on, but it may be possible to pick out both Mercury and Venus in the sunset at a southern station just after Saturn has risen, the best chance of success being right at the end of the month.

Announcements

IT is announced in *Science* that Dr. R. H. Fowler, Plummer professor of mathematical physics in the University of Cambridge, has been appointed visiting lecturer in mathematics at Princeton University for the second term of next year.

THE annual autumn meeting of the Institute of Metals will be held in Newcastle-upon-Tyne on September 9–12, under the chairmanship of Dr. Harold Moore, president of the Institute. The Autumn Lecture will be delivered on September 9 by Dr. H. W. Brownsdon, who will take as his subject "Metal Melting—Its Effect on Quality"; the lecture will be followed by a discussion. Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

A SPECIAL train has recently been organised in Germany for the rapid conveyance of first aid to any place where a great disaster such as a flood or earthquake has taken place.

ERRATUM. Prof. Hans Falkenhagen writes, in reference to the letter in NATURE of May 18, p. 830, entitled "Compressibility of Electrolytic Solutions", by Ch. Bachem and himself, that the expression $k = Ac + Bc^{3/2}$, as written by them, is incorrect. It should read $k = C + Ac + Bc^{3/2}$.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A technical officer at the Royal Aircraft Establishment, South Farnborough, Hants, to assist in the investigation of aircraft problems relating to aerodynamics, strength and stiffness—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants, quoting A. 734 (July 29).

An assistant (Grade II) at the Building Research Station for work on problems connected with painting and decoration—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1 (July 31).

A lecturer in mathematics with subsidiary biology at the Saltley Church of England Training College for Schoolmasters, Birmingham—The Principal (Aug. 1).

An engineer officer for the Indian Mercantile Marine Cadets Training Ship *Dufferin*—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 1).

An assistant lecturer in inorganic and physical chemistry, University College of the South West, Exeter—The Registrar (Aug. 5).

A full-time and a part-time graduate assistant in the Department of Mechanical Engineering, Guildford Technical College—Director and Secretary, Technical College, Park Street, Guildford.

Part-time lecturers in automobile engineering, drawing and design, and workshop processes in the Mechanical Engineering Department, The Polytechnic, Regent Street, London, W.1—Director of Education.

An assistant lecturer in civil engineering in the Battersea Polytechnic, London, S.W.11—The Principal.

A lecturer in plant pathology and zoology at the Swanley Horticultural College for Women, Swanley, Kent—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 148.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Thermo-electric Effect and the Supra-conducting State

USING the supra-conducting galvanometer described in a previous issue of NATURE[1], we have tried to measure the thermo-electric effect of lead and tin when they were both supra-conducting. The method used to obtain a temperature difference between the junctions was similar to that described by Borelius, Keesom, Johansson and Linde[2].

One junction, A, was immersed in liquid helium, and its temperature was regulated by controlling the pressure over the liquid. The second junction, B, was enclosed in a metal container which was also immersed in the liquid helium; this container could be evacuated independently of the outer chamber containing liquid helium and so isolated thermally except for the metal connexions from B to the outside. The temperature of the junction B was first brought to the same value as A by the thermal conduction of the low-pressure helium gas in the B container; the temperature of B, which was measured by a helium gas thermometer, could be raised by means of a constantan heating coil.

With the temperature of A at 3·8° K. and B at a somewhat higher temperature, a current was registered by the galvanometer. With A at 2·0° and B anywhere between 2·0° and 3·7°, no current was indicated. When B was raised above 3·7°, while A remained at 2·0°, a current flowed in the galvanometer.

Since the supra-conducting point of lead is 7·2° K. and that of tin 3·7° K., we can conclude from this experiment that no thermo-electric effect exists when both junctions are in the supra-conducting state, but the effect comes in when either one of the junctions is raised above the supra-conducting point of one of the metals.

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[1] NATURE, 135, 906; 1935.
[2] G. Borelius, W. H. Keesom, C. H. Johansson and J. O. Linde, *Leiden Comm.*, No. 217 *c*. Or *Proc. Kon. Akad. Amsterdam*, 34, 1365; 1931.

The Masses of Be^8 and C^{12}

THE recent set of nuclear masses proposed on the basis of disintegration experiments[1] includes the values 4·0034 for He^4, 8·0071 for Be^8 and 12·0027 for C^{12}. From these values it follows that the binding energy of two α-particles is either slightly negative or else very small (less than 200,000 volts) whereas that for three α-particles is quite large (7×10^6 volts). This seems surprising, but may be obtained simply without assuming anything more than a Gamow type of interaction between two α-particles. Thus, taking this interaction potential in the form

$$V = 4e^2/r \,, r > r_0 \,;$$
$$= -c \quad , r < r_0 \,;$$

with c and r_0 related in such a way as to give a certain small value for the binding energy of Be^8, one finds that the observed mass of C^{12} may be obtained by suitable adjustment of the single parameter r_0. For example, taking 200,000 volts for the binding energy of Be^8, a value of r_0 slightly greater than 2×10^{-13} cm. will give the observed mass of C^{12}. Smaller values of r_0 than this give rise to increasingly larger binding energies than the observed, and these results are not critically dependent on the value assumed for the binding energy of Be^8. More precise limits for r_0 will be fixed by consideration of heavier nuclei.

We have here a further example of the sensitivity of binding energies for short range fields to changes in the field parameters.

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[1] Oliphant, Kempton and Rutherford, *Proc. Roy. Soc.*, A, 150, 241; 1935. Bethe, *Phys. Rev.*, 47, 633; 1935.

Deposition of Artificial Radio-Elements by Electrochemical Exchange

THE method of preparation of sources of some natural radio-elements (polonium, radium C, etc.) on metallic plates by electrochemical exchange and the advantages that it presents are well known. I have tried to apply the method to the separation of radio-copper (period 10 hr.) from zinc. Preliminary experiments have shown that, of the metals nickel, tin, lead and iron which are in the series of tension between copper and zinc, lead gives the best results. The following method has been adopted:

8–12 gm. of zinc powder is attacked by concentrated hydrochloric acid, after irradiation by neutrons, until a residue of 200–300 mgm. remains. This is separated by filtration from the solution. Measurements made with the aid of a Geiger-Müller counter show that *practically all the activity is concentrated on the non-dissolved zinc*. The latter is now dissolved separately in concentrated hydrochloric acid and diluted with about two volumes of distilled water. A plate of lead of suitable dimensions and with one side covered by an insulating material is then rotated in this solution. After 30 minutes, more than half the radio-copper is deposited on the plate.

The method permits the preparation without co-precipitant and, consequently, without absorption of activity, of strong sources of radio-copper in extremely thin layers. Unfortunately, it is not applicable to other known artificial radio-elements, since the elements obtained up to the present by neutron bombardment are generally either isotopes of the elements bombarded or electrochemically less noble.

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Disintegration Constant and the Upper Limit of the Continuous β-Spectrum

SARGENT[1] discovered the relation between the disintegration constant of the radioactive elements which decay by emitting a β-particle and the upper limit of the continuous β-spectrum. He found that in the diagram obtained by plotting the logarithms of the disintegration constants against the logarithms of the upper limits, a straight line can be drawn through the points for RaE, $MsTh_2$, ThC and RaC, and a curved line through the points for RaD, UX_1, ThB, AcC″, ThC″ and UX_2. The points for AcB and RaB do not fall on either of these curves.

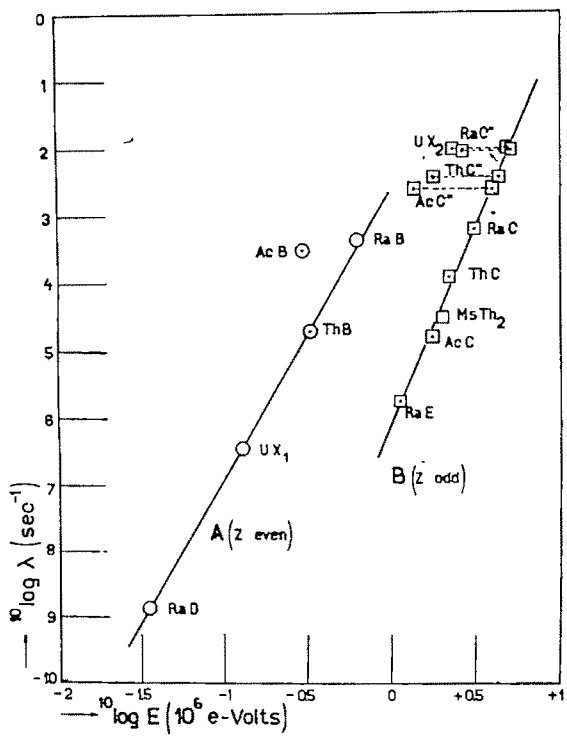

FIG. 1.

Recently, I remarked[2] that a simple diagram is obtained if the upper limits are plotted against $M - 1{\cdot}5Z$ (M = mass number, Z = charge number). From this diagram the upper limits of the elements AcC and RaC″, which are not yet measured, can be estimated with good approximation. Using the two values obtained in this way ($1{\cdot}8_1 \times 10^6$ and $2{\cdot}6_7 \times 10^6$ electron volts respectively) to complete Sargent's diagram, one finds that the point for AcC falls on the straight line and that for AcC″ on the curved line. In the same communication I directed attention to the fact that the upper limits are generally higher for the elements with odd charge number, than for those with even charge number. From this fact the question arose whether the difference between the even and the odd elements might be of interest for the interpretation of Sargent's diagram.

That this is really the case can be seen from Fig. 1, in which the diagram is reproduced completed with the points for AcC and RaC″. Instead of the curved line mentioned above, a straight line is drawn through the points for RaD, UX_1, ThB and RaB. Now, in the diagram, three groups of points are to be distinguished: (1) Points for the elements with *even charge number* which, with the single exception of AcB, fall on the straight line A; (2) points for the elements with *odd charge number*, RaE, AcC, $MsTh_2$, ThC, RaC, which fall on the straight line B; (3) points for the elements with *odd charge number* AcC″, ThC″, RaC″, UX_2.

If λ is expressed in sec.$^{-1}$ and E in 10^6 e.-volts (and if logarithms to the base of ten are used) the straight lines correspond to the formulæ:

$$A\ (Z \text{ even}):\ \log\lambda = -2{\cdot}63 + 4{\cdot}35\log E = -2{\cdot}63 + 1{\cdot}45\log E^3.$$

$$B\ (Z \text{ odd}):\ \log\lambda = -6{\cdot}11 + 5{\cdot}80\log E = -6{\cdot}11 + 1{\cdot}45\log E^4.$$

If the energy of an electron, $m_0c^2 = 0{\cdot}510_4 \times 10^6$ e.-volts, is used as unit of energy, these equations become:

$$A\ (Z \text{ even}):\ \log\lambda = -3{\cdot}90 + 1{\cdot}45\log E^3.$$
$$B\ (Z \text{ odd}):\ \log\lambda = 2(-3{\cdot}90 + 1{\cdot}45\log E^2).$$

It may be of interest to remark that the four elements of the third group are all 'branch products'. Further, it was found, as is indicated in Fig. 1 by the dotted lines, that the points belonging to these four elements all can be brought on to the straight line B by adding $2{\cdot}6_2 \times 10^6$ e.-volts to the value of the upper limit. This can scarcely be a mere chance. Moreover, this energy of $2{\cdot}6_2 \times 10^6$ e.-volts is just equal to the energy of the intense γ-radiation which is emitted by ThC″, and is the hardest γ-radiation known. A γ-radiation of about the same energy is also observed with RaC + C′ + C″. Here it is generally ascribed to RaC, but the possibility does not seem excluded that it has its origin in the nucleus of RaC″. Perhaps it would repay the trouble to look for such a hard γ-radiation also with UX_2 and AcC″.

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[1] B. W. Sargent, *Proc. Roy. Soc.*, A, 139, 659; 1933.
[2] G. J. Sizoo, *Physica*, 2, 472; 1935.

Diffraction of X-Rays and Electrons by Carbon Tetrachloride Vapour

RECENT electron-diffraction investigations[1] of the molecular structure of gaseous carbon tetrachloride give values of the interatomic distances, which are appreciably lower than those obtained in earlier electron-diffraction measurements and those obtained by Bewilogua[2] from X-ray photographs. This discrepancy of about 4 per cent is so important that it cannot be explained by the probable errors given by the authors. As, moreover, carbon tetrachloride is generally used as a standard substance for testing the apparatus, it

seemed to us to be of interest to compare X-ray and electron-diffraction results from as wide a field as possible with the corresponding theoretical calculation, using in both cases the most trustworthy experimental methods.

The electron-diffraction apparatus used for this purpose was that constructed by de Laszlo[3]. We developed a narrow tube system, which absorbs the primary electron beam as soon as it leaves the vapour-jet system. This made it possible to reduce the pressure in the vapour-jet system and thereby all disturbing scattering effects. Perfect microphotometer records could be obtained of the photographic plates by rotating them at high speed. All influence of grain and dust was thus avoided. The theoretical scattering curve was obtained in the usual way, introducing the atomic form factors of James – Brindley and Heisenberg – Bewilogua's S-values for inelastic scattering. Supposing the atomic part of the theoretical intensity curve (monotonic curve, representing the total intensity without the details concerning molecular structure) rendered correctly by the corresponding experimental values, the influence of molecular structure on the atomic part of intensity could be compared with good accuracy.

We found that, at the first minimum and maximum, good agreement of theory and experiment could be obtained. At the fifth apparent maximum, however, the theoretical curve was more prominent than the record indicated. This discrepancy may be explained by the influence of thermal vibrations, which is rather important in this region. Using James's formula[4] for this correction, we found that excellent agreement could be obtained. However, the detection of this thermal vibration effect had no influence on the interatomic distance measurements. The study of microphotometer records and the generally used visual measurements of ring diameters at large scattering angles both gave values for the chlorine-chlorine distance of $2 \cdot 86 \pm 0 \cdot 03$ A. and for the carbon-chlorine distance $1 \cdot 75 \pm 0 \cdot 02$ A. These values are in excellent agreement with those mentioned previously[1].

Up to the present time, the X-ray distance measurements of Bewilogua have never been controlled. Meanwhile, one of us[5] has shown, however, that a more satisfactory agreement of intensity values could be obtained, if monochromatic X-rays were used; but the large volume of gas effective in scattering did not allow of the determination of trustworthy interatomic distances. An improved form of this arrangement with a circular mica window closing the vapour tube, combined with a powerful X-ray source, made it possible to reduce considerably the scattering volume of gas and to avoid the corresponding correction. With copper $K\alpha$ radiation, two maxima and three minima, with molybdenum $K\alpha$ radiation, five maxima and minima could be measured. The agreement between microphotometer records and corrected theoretical intensity curves was satisfactory in both cases and accurate distance measurements could be obtained. The mean values from several photographs are: $2 \cdot 85 \pm 0 \cdot 03$ A. for the Cl-Cl distance and $1 \cdot 74 \pm 0 \cdot 02$ A. for the C-Cl distance. These values are appreciably lower than those given by Bewilogua, and it seems that the experimental improvements effected are the reason for it.

The present investigation shows that the diffraction of X-rays and electrons by carbon tetrachloride agrees with theoretical calculation and both lead to the same values of interatomic distances.

Full details will be published shortly in the *Physikalische Zeitschrift*.

This work was carried out under the guidance of Prof. Debye in the Chemical Institute of the University of Liége.

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[2] L. Bewilogua, *Phys. Z.*, 32, 265; 1931.
[3] H. de Laszlo, *Proc. Roy. Soc.*, A, 146, 672; 1934.
[4] R. W. James, *Phys. Z.*, 33, 737; 1932.
[5] W. v. d. Grinten, *Phys. Z.*, 34, 609; 1933.

Interaction between Acetylcholine and Sterols in Tissues

WE have recently carried out some experiments on the form of the contraction given by the gastrocnemius muscle of a winter frog[1] in response to a single electrical stimulus. In certain circumstances, of which the most important is the presence of thyroxine at slightly above the physiological concentration in the Ringer's solution in which the muscle is bathed, the muscle gives an abnormal prolonged contraction if either acetylcholine or one of several sterols is added to the medium. This abnormal contraction greatly resembles a tetanic contraction in form. It is of exactly the same type whether it is produced by the addition of acetylcholine or of a sterol. Further, if both acetylcholine and a sterol are added to the medium together, in a proportion which is different for different sterols but is well-defined for each, the contraction remains a normal twitch and shows no tendency to become prolonged. So long as this proportion between the concentrations of acetylcholine and sterol in the medium is maintained, the concentrations of both may be altered over a wide range and the contraction will remain a normal twitch.

These conclusions are illustrated by the results of the following experiment. A muscle was set up in a modified Ringer's solution containing acetylcholine at a concentration of $1/10^6$ by weight. After 60 min. it responded (to stimulation of its nerve by a single shock) with a prolonged contraction of $1 \cdot 4$ sec. Ergosterol $1/10^5$ was then added to the medium, which was otherwise unaltered. In ten minutes the contraction had returned to a normal twitch and it remained thus for 20 min., when it again lengthened. At 60 min. it was $2 \cdot 35$ sec. long. The concentration of acetylcholine was then raised to $1/10^5$, and the contraction again shortened and afterwards again lengthened to a prolonged contraction of $1 \cdot 7$ sec Finally, the concentration of ergosterol was raised to $1/10^4$. In a further 60 min. the contraction had once again returned to a normal twitch. Later, it again lengthened to a prolonged contraction of $1 \cdot 5$–$1 \cdot 9$ sec.

Results such as these have been obtained in many experiments. They show, first, that the normal twitch may occur with very different concentrations of acetylcholine and sterol. Secondly, it seems that the only way that the return to the normal twitch and the later resumption of the prolonged contraction after each addition of acetylcholine or sterol can be interpreted is to suppose that a balance between the concentrations of acetylcholine and sterol in the tissue is necessary if the contraction is to have the

form of a normal twitch. After each addition, the added substance diffuses into the tissue, and this balance is first re-established (when the contraction becomes a normal twitch), and then overturned on the opposite side (when the prolonged contraction is resumed). We do not wish to draw any conclusions from the actual concentrations of acetylcholine added to the medium. This substance breaks down rapidly in solution and it is probable that in such experiments as these the concentration in the muscle is not equivalent to that added to the medium.

So far, only a few sterols have been used in these experiments, but all those we have used are active to a greater or less extent. Cholesterol, both as supplied by The British Drug Houses and as a highly purified sample, was found to have one fifth the activity of ergosterol: di-hydrocholesterol had one tenth the activity of cholesterol. A few other sterols have been used. All these sterols were suspended in the medium with lecithin, which was itself shown to be inactive.

In view of these results, we have thought it worth while to investigate the action of sterols on the beat of the frog's heart, in order that any action of these substances might be compared with the well-known action of acetylcholine. We have obtained results which are parallel to those of our experiments on muscle. When the sterol is placed in the medium circulating through a heart, the beat is reduced in height and slowed and, if the quantity of the sterol is sufficient, the heart is stopped for a time. The reaction of the heart is precisely similar to its reaction to acetylcholine. Frogs' hearts vary greatly in their sensitivity to acetylcholine and sterols, and for this reason it is not so easy to balance a concentration of acetylcholine against one of a sterol in these experiments as in those on muscle. But, if the quantities of acetylcholine and sterol which are necessary to produce stoppages of equal length in the same heart are determined, and these quantities of both substances are then placed together in the medium, the change in the heart beat is very much less than is produced by either separately and often there is no change at all. As in the experiments on muscle, it seems that if a certain proportion is maintained between the concentrations of acetylcholine and sterol, the normal behaviour of the tissue is not disturbed, although the concentrations of both acetylcholine and sterol in the tissue are greatly altered.

Since both acetylcholine and sterols are natural constituents of animal cells, we think that these results suggest that, at least in the phenomena which we have investigated, the sterols play a part in the same chemical processes as those in which acetylcholine is concerned; and that a definite proportion between the concentrations of acetylcholine and sterols in the tissue is necessary for its normal functioning. Since several sterols are active in these phenomena, it is clear that many of the sterols can replace each other in this as in their other actions, and that the activity of any one sterol is no proof that it is the natural active substance.

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[1] Carter, G. S., *J. Exp. Biol.*, **10**, 256; 1933.

Estimation of Ascorbic Acid by Titration

UNDER this title McHenry and Graham[1] have published an investigation on the ascorbic acid content of raw and cooked foodstuffs. They found in the case of cauliflowers, carrots, parsnips, beets and potatoes more ascorbic acid in the cooked than in the raw food (determined by the method of Birch *et al.*). They believe the increase is due to the setting free of bound ascorbic acid, perhaps from an ester. In the case of certain plant tissues, then, a simple extraction and titration procedure does not give the complete value of ascorbic acid, but only measures the free acid.

From the following observations (Tables I and II) I conclude that this view is not correct, and that the increase by cooking is not a real increase; in reality, after cooking the ascorbic acid content decreases.

Table I.
mgm Vitamin C in 10 gm. of a single potato under various conditions of extraction.

1.	Ground up in a mortar under trichloroacetic acid (3 per cent)	3·05
2.	Extract (1) after mercuric acetate and hydrogen sulphide treatment*	3·11
3.	Ground up without trichloroacetic acid and then diluted with trichloroacetic acid	0
4.	Extract (3) after mercuric acetate and hydrogen sulphide treatment	3·11
5.	Ground up under trichloroacetic acid after addition of 2·25 mgm. ascorbic acid	5·36
6.	Extract (5) after mercuric acetate and hydrogen sulphide treatment	5·35
7.	Ground up without trichloroacetic acid after addition of 2·25 mgm. ascorbic acid and then diluted with trichloroacetic acid	0·36
8.	Extract (7) after mercuric acetate and hydrogen sulphide treatment	5·35

Table II.
mgm. Vitamin C in 10 gm. of a single potato before and after cooking.

1.	Ground up under trichloroacetic acid before cooking	3·18
2.	Extract (1) after mercuric acetate and hydrogen sulphide treatment	3·21
3.	After cooking for 45 min., then ground up with trichloroacetic acid	2·67
4.	Extract (3) after mercuric acetate and hydrogen sulphide treatment	2·59
5.	After cooking for 45 min., then ground up without trichloroacetic acid and diluted with trichloroacetic acid	2·59
6.	Extract (5) after mercuric acetate and hydrogen sulphide treatment	2·48
7.	Ground up, cooked for 45 min., then diluted with trichloroacetic acid	0
8.	Extract (7) after mercuric acetate and hydrogen sulphide treatment	0·13

Hence it follows that the apparent increase must be attributed to the destruction of an oxidase present in some vegetables*, which changes the reduced ascorbic acid into the reversibly oxidised state when the vegetables are ground up. Therefore it is necessary to reduce the extract with hydrogen sulphide after mercuric acetate precipitation[2]. This oxidase is not active in 3 per cent trichloroacetic acid solution. So the discrepancy may be caused by omitting or adding too small quantities of trichloroacetic acid at the moment of grinding up the vegetables. The oxidase is destroyed by cooking, so that in an extract of cooked vegetables the vitamin is not oxidised.

Finally, attention must be directed to the fact that when determining the ascorbic acid content in blood, an analogous phenomenon takes place. The ascorbic acid in the blood is present in the reduced state. This is proved by the fact that the serum extract before and after mercuric acetate and hydrogen sulphide treatment contains the same amount of

* Tauber and Kleiner have isolated an 'ascorbic acid oxidase' from Hubbard squash (*Proc. Soc. Exp. Biol. and Med.*, **32**, 577; 1935), Szent-Gyorgyi a 'hexoxidase' from cabbage leaves (*J. Biol. Chem.*, **90**, 385; 1931). The oxidation of ascorbic acid by potato juice is due to the polyphenoloxidase, which oxidises phenol to quinone, then the quinone oxidises the ascorbic acid (Szent-Györgyi und Vietorisz, *Biochem. Z.*, **233**, 236; 1931).

ascorbic acid. However, in the presence of erythrocytes, the ascorbic acid is reversibly oxidised when precipitating the blood with trichloroacetic acid. Hence only after reduction with hydrogen sulphide (after mercuric acetate precipitation) can the quantity of ascorbic acid be determined[3].

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[1] McHenry and Graham, NATURE, 135, 871; 1935.
[2] Emmerie, *Biochem J*, 28, 268, 1934. Emmerie and Van Eekelen, *Biochem. J.*, 28, 1153; 1934.
[3] Van Eekelen, Emmerie, Josephy and Wolff, *Klin. Wschr.*, 13, 564; 1934.

Proteolytic Digestion in the Ammocœte Larva

MISS ALCOCK[1], in an early publication on digestion in the ammocœte larva, stated that extracts of the liver, alimentary canal and skin showed proteolytic activity of the peptic type. More recently, however, Berrill[2,3] has described an enzyme of the tryptic type in the 'liver' and skin (hatching enzyme) of ascidians, and in view of the phylogenetic relationship between these forms, Miss Alcock's work, which was carried out before the realisation of the importance of *p*H control, clearly demands reconsideration.

In the course of investigations, still in progress, into the problems of digestion in the Cyclostomata, I have found that proteolytic digestion in the ammocœte larva of the brook-lamprey is in fact markedly similar to that of the Ascidiacea, for in extracts of the anterior end of the so-called mid-gut (by which is meant the main wide portion of the intestine) and of the skin, it is possible to demonstrate, using as substrates casein (for formol – caustic soda titration) and gelatine, strong proteolytic activity of the tryptic type, the optimum being at about *p*H 8. The intestinal extract is stronger than that of the skin. No such effect is obtainable from extracts of the liver or of the remainder of the mid-gut, although all four extracts show a very weak proteolytic activity in an acid medium of a *p*H at least as low as 1·5; the most reasonable explanation of this latter effect would seem to be that it is due to the presence of an autolytic tissue enzyme.

With regard to the localisation of the digestive enzyme in the mid-gut, it may be noted that recent work (Boenig[4], Cotronei[5] and others) on the so-called 'pancreas' of the Cyclostomata appears to have established firmly the fact that this organ is exclusively endocrine in nature, Cotronei pointing out that the zymogen cells must therefore still be confined to the intestinal epithelium. Now Brachet[6] had previously directed attention to the presence in the epithelium at the anterior end of the mid-gut of specialised granular cells, characterised especially by the possession of very large nucleoli, and had suggested that these might represent a localisation of zymogen cells. It will be seen that my results indicate that the proteolytic enzyme of the mid-gut is produced in precisely this region.

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[1] *J. Anat. Physiol.*, 33; 1899.
[2] *Brit. J. Exp. Biol.*, 6; 1929.
[3] *Phil. Trans. Roy. Soc.*, B, 218; 1929.
[4] *Z. mikr.-anatom. Forschung*, 17; 1929.
[5] *Pub. Staz. Zool. Napoli*, 8; 1927.
[6] *Anat. Anz.*, 13; 1897.

Guanine in the Excreta of Arachnids

SINCE the work of Gorup-Besanez and Will in 1849[1], it has been classical to regard guanine as taking the place of uric acid as the main nitrogenous end-product of arachnid metabolism. This view is accepted in all the monographs on comparative biochemistry, such as that of von Furth[2], but it appears to rest wholly on colour tests of uncertain value and deductions from crystal form.

Accordingly, it was thought desirable to examine the Arachnida and their metabolic products with the aid of the specific deaminating enzyme guanase which occurs in mammalian (rabbit) liver and forms xanthine from guanine. A number of different species of spider were examined, and the work will be continued on tropical material in Siam. Here only the experiments on the collected excreta of the common garden spider, *Epeira diadema*, will be mentioned. By this specific method, following the details given by G. Schmidt[3], an average of 12 per cent of the weight of the excreta was found to be guanine. In view of the fact that no separation of the product of the Malpighian tubes from that of the gut was made, this figure is fairly considerable.

This is the first demonstration of the presence of guanine in arachnid excreta using a specific enzyme.

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[1] Gorup-Besanez und Will, *Ann. Chem. u. Pharm.*, 69, 117; 1849
[2] von Furth, "Vergl. Chem. Physiol. nied. Tiere", p. 298, 1903.
[3] G. Schmidt, *Z. physiol. Chem.*, 208, 225, 1932.

Structure of the Proboscis in Blood-Sucking Diptera

DR. S. K. SEN[1] has expressed the view that the food-canal of blood-sucking Diptera is not formed, as is generally supposed, by the apposition of the labrum-epipharynx and the hypopharynx, but that it is actually the lumen of the hypopharynx itself, a channel which has been regarded hitherto as the continuation of the salivary duct. From the studies I have made it appears to me that this view is quite incorrect. An adequate reply to Dr. Sen would occupy too much space in this journal, but I have fully explained my views in various papers in *Parasitology* (1926, 1928, 1929 and 1932) and I must ask those who are interested in the subject to refer to them.

Dr. Sen says that the labrum-epipharynx is entirely unconnected with the buccal chamber (termed *hyoid* in my papers), but in fact in all the blood-sucking Diptera which I have studied, the epipharynx is continuous posteriorly with the dorsal part of the wall of the hyoid or, if this sclerite is absent, with the anterior membranous wall of the pharynx. The apodemes (termed *stipites* in my papers) do not separate the labrum-epipharynx either from the buccal chamber (hyoid) or from the hypopharynx, since each of them is attached to the postero-lateral part or to the posterior process of the labrum. Furthermore, as regards the statement that the salivary duct terminates at the base of the hypopharynx, this view again appears unsound, since in all blood-sucking Diptera, with the exception of those of the genus *Culicoides*, the common salivary duct penetrates the hypopharynx and opens at its tip[2].

Dissection is of value only for the study of the general structure of the proboscis and its various components; the relation of these to each other, especially in the guttered part of the labium, can only be studied in complete series of transverse sections. It is, moreover, misleading to base any generalisation upon the study of a single species of this large order of insects.

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[1] NATURE, 135, 915, 1935.
[2] Jobling, *Bull. Ent. Res.*, 1928.

Kinetics of Heterogeneous Catalysis and of Enzyme Action

THE activation of the adsorbate recently described in NATURE[1] was explained by the formation of an adsorption complex $E{-}S+$ in which the adsorbed molecule S has gained a quantum of rotation-vibrational energy from the surface molecule E. This complex will be dissociated into $E+S+$ by the supply to it of a quantity of energy equal to that transferred from E to S in the formation of the complex. If the energy of activation of the free molecules $S+$ be the critical increment of one of the reactions of the substance S, that reaction will be promoted by the surface of E molecules.

If now the number of molecules in the available surface be represented by E and the molecular concentration of the reactant (assumed to be constant) be represented by S, the initial velocity of formation of the adsorption complex will be k_1SE and at time t the velocity will have fallen to $k_1S(E-x)$, where x is the number of adsorption complexes which have been formed. The velocity of dissociation of these complexes at time t will be $k_2xe^{-Q_1/RT}$, where Q_1 is the amount of energy transferred from surface to adsorbate in forming the complex. If the concentration of S be constant, a stationary state will be established at which the velocity of the reaction promoted by the surface will be given by

$$r = k_1S(E-x) = k_2xe^{-Q_1/RT}.$$

By the elimination of x we have

$$r = \frac{k_1SEK}{k_1S+K}, \text{ where } K = k_2e^{-Q_1/RT}, \text{ and}$$

$$\log \frac{r}{k_1SE-r} = \log \frac{k_2}{k_1S} - Q_1'/T, \text{ where } Q_1' = Q_1/2{\cdot}303R.$$

If now the substance E be itself adsorbed as a unimolecular layer on a surface C with the formation of the adsorption complex $C{-}E+$, the molecules of E will now be activated, the energy of activation being denoted by Q_2. When these activated molecules adsorb the reactant S there will be formed the adsorption complex $C{-}E{-}S++$, in which the total energy of activation of $S++$ is Q_1+Q_2. This complex will be resolved by the absorption of the energy Q_1 into $C{-}E+S++$ and the de-activated catalyst $C{-}E$ will be reactivated to $C{-}E+$ by the absorption of the energy Q_2. In this manner a reaction with a total critical increment of Q_1+Q_2 can be promoted by an adsorbed catalyst, the total energy being absorbed from the surroundings in two separate and distinct stages.

By analogy with the above simple case a stationary state will be established, if the concentration of the reactant S be maintained constant, the reaction velocity being given by

$$r = k_1S(E-x-y) = k_2xe^{-Q_1/RT} = k_3ye^{-Q_2/RT}.$$

By the elimination of x and y we obtain the same expression as before, namely:

$$r = \frac{k_1SEK^1}{k_1S+K^1};$$

$$\text{but } K^1 = \frac{k_2k_3e^{-(Q_1+Q_2)/RT}}{k_3e^{-Q_1/RT} + k_2e^{-Q_2/RT}}.$$

$$\text{Since } \frac{e^{-(Q_1+Q_2)/RT}}{e^{-Q_1/RT}+e^{-Q_2/RT}} = \frac{e^{-Q_2/RT}}{1+e^{(Q_1-Q_2)/RT}},$$

the exponential term has a maximum value of $\frac{1}{2}e^{-Q_2/RT}$ when $Q_1=Q_2$. If $Q_1=Q_2$, there will be two exactly similar processes taking place under identical conditions and hence it is legitimate to assume that $k_2=k_3$.[4] On these two assumptions the expression for the reaction velocity is much simplified and may be written in the forms

$$r = \frac{k_1SE \times 0{\cdot}5k_4e^{-Q_2/RT}}{k_1S + 0{\cdot}5k_4e^{-Q_2/RT}}$$

$$\text{and } \log \frac{r}{k_1SE-r} = \log \frac{k_4}{2k_1S} - Q_3'/T,$$

where $k_4=k_2=k_3$, $Q_3'=Q_2/2{\cdot}303R$ and Q_2 is one half the total critical increment of the reaction promoted by the adsorbed catalyst.

It may be suggested that enzyme reactions are of this two-stage activation type, since there is little doubt that the enzyme is adsorbed on the co-enzyme. The virtue of such an enzyme system is due to the fact that it is able to promote within a living organism a reaction the critical increment of which is so large that it cannot otherwise take place with measurable velocity at the temperature of that organism.

The equations and the specificity of enzyme systems will be described more fully in a further communication, but one important conclusion may be stated. Neither the critical increment of a heterogeneous reaction nor that of the de-activation of an enzyme system can be determined directly from measurements of the reaction velocity at two different temperatures, since it is $\log \frac{r}{\text{const.}-r}$ and not $\log r$ which is linear with the reciprocal of the absolute temperature.

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[1] NATURE, 136, 28, July 6, 1935.

Shape of the NO_2 Molecule

IN a recent paper[1], one of us has shown that the available data[2] on the contours of the infra-red bands of NO_2 are most consistently interpreted by a ring-like structure for the molecule, with the O–N–O angle approximately 60°. The theory of directed valency was employed there to provide a possible electronic configuration for this model. Closer investigation of the electronic structure, however,

indicates that a much more probable form has the O–N–O angle in the neighbourhood of 110°–120°.

Dr. R. M. Badger and Dr. G. Herzberg have suggested independently[3] that the wide-angled form is the correct one. The former points out that a ring-like structure would be inconsistent with the low value (641 cm.$^{-1}$) observed for the frequency ν_2, while the latter shows that the fine-structure of the ultra-violet bands[4] indicates a rather flat molecule. On these grounds, they both suggest a re-assignment of the fundamental frequencies as shown in the accompanying table. The object of this re-assignment is to avoid difficulties which would otherwise arise in interpreting the observed contours of the infra-red bands. A discussion of these cannot conveniently be given here.

Fundamental Frequencies of the NO_2 Molecule in cm.$^{-1}$.

Designation	ν_1	ν_2	ν_3
Sutherland	1373	641	1615
Badger and Herzberg	1615	641	1373

We have recently been making a study of the force fields in triatomic molecules, more particularly of the force constant controlling the bending frequency (ν_2), and from it we find that the wide-angled structure for NO_2 is definitely to be preferred. We find, moreover, that the original assignment of the fundamental frequencies seems more likely to be the correct one. This immediately leads to difficulties regarding the contours of the infra-red bands, which Badger and Herzberg's re-assignment was designed to avoid. Since the latter does not, however, resolve all the difficulties, we feel that an extensive and careful re-examination of the contours of the infra-red bands will be necessary before these can be used as a reliable guide to the shape of the molecule.

A full account of these investigations will be published later elsewhere.

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June 19.

[1] Sutherland, *Proc. Roy. Soc.*, A, **145**, 278; 1934.
[2] Bailey and Cassie, NATURE, **131**, 239; 1933. Harris, Benedict and King, NATURE, **131**, 621; 1933. Schaffert, *J. Chem. Phys.*, **1**, 507; 1933.
[3] In private communications, which we gratefully acknowledge.
[4] Hermann, *Ann. Phys.*, **15**, 89; 1932.

Influence of Viscosity Variation on the Rupture of Plastic Bodies

THE term viscosity has frequently been used in a qualitative sense in describing the properties of solids and particularly of metals, but its use in the quantitative sense which has been developed through the study of liquids is a comparatively recent development. Viscosity may be defined quite generally as the ratio of the shearing stress in any plane to the rate of shear or velocity gradient perpendicular to the plane. Thus defined it appears always to be a variable quantity for solids, its value depending on a number of factors, but particularly on the magnitude of the shearing stress. No emphasis appears, however, to have been laid on the importance of the *degree of variability* of the viscosity in relation to the rupture of plastic solids.

The point is most easily explained by reference to 'runny' materials to which standard viscometric methods may be applied: (we avoid the word 'fluid', because this is sometimes taken to imply a constant viscosity). If some golden syrup is sucked up into a tube 10–20 cm. long, and about 1 cm. in diameter, it will run out quite continuously without forming drops. A clay paste, on the other hand, falls from the end of the tube in 'blobs' (they can scarcely be called drops). The surface tension is about the same in the two cases, and its influence is not large owing to the use of a very wide tube. The difference in behaviour must be due to viscosity. It cannot be a question of the absolute magnitude of the viscosities, as these can be considerably changed by altering the concentrations of sugar and clay without making the two materials behave alike. We can only attribute the difference to the fact that while the viscosity of a sugar syrup is independent of the stress, that of a clay paste varies very greatly, particularly in the neighbourhood of its 'yield value'. Soft soap, when warm, will run from such a tube, and has a viscosity which is not constant like that of syrup, but yet is not as steeply variable as that of a clay paste. It is interesting to observe that in falling from the tube this material forms blobs which, if they do not have to fall too far, do not become completely detached from one another. Its behaviour is thus intermediate, as we should expect.

We are not aware that similar reasoning has, as yet, been applied to the behaviour of solids in tension. In the case of flour dough we have developed, for the quantitative measurement of viscosity, a technique which has been considerably extended and improved in co-operative work with Dr. P. Halton of the Research Association of British Flour Millers, and there are strong indications that shortness in a dough is associated with a particularly rapid decrease of viscosity with increase in shearing stress. We have not sufficient personal experience with metals to make any assertion about their behaviour, but we venture to suggest that the rate of decrease of viscosity (as defined above) with increase in shearing stress may be a determining factor in their tensile strength. A general connexion between the manner of rupture and the degree of variability of viscosity may be found to hold even though the underlying mechanism is quite distinct as between different kinds of materials.

In practice, the position is apt to be obscured by factors in addition to shearing stress which influence viscosity. For example, heather (*Calluna vulgaris*) honey if kept in the tube overnight sets to a thixotropic gel which causes it to fall in blobs, whereas after stirring it behaves substantially like syrup. Again, flour dough strain-hardens on extension. As with metals, this delays 'necking' when cylinders of this material are extended.

The behaviour of rubber in benzene differs from both syrup and clay pastes because it has a much longer relaxation time (ratio of viscosity to rigidity modulus). We suggest, however, that such factors, though introducing complications, do not necessarily upset the postulated relationship between the degree of variability of viscosity and the manner of rupture, and that it may prove illuminating in the study of many materials.

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Electrical Units and the I.E.C.

SIR RICHARD GLAZEBROOK says[1]: "It is recognised that in addition to the three accepted units of length, time and mass a fourth unit is required for the specification of electrical quantities". Recognised by whom? What has happened to the upholders of the old doctrine that these three quantities are possessed of some mystical peculiarity in virtue of which they are necessary and sufficient as 'fundamental units'? Is it abandoned; if so, what do those who held it now believe? Or has a fourth magnitude possessed of this mystical property been found; if so, what is it?

Though I may be in a minority of one, I ask leave to repeat the conclusions that I have expounded at such length in my "Measurement and Calculation". If a 'unit' means something fixed by arbitrary choice and not by facts, then, if n quantities are to be defined, at least n 'units' are necessary. If it means a choice made by assigning a value to some arbitrarily constructed body or system, then no 'unit' is necessary (as Planck's 'natural' system shows), and the number of 'units' that is convenient is a matter of opinion. An 'absolute system', if it means anything, means one in which arbitrary choices are made so as to make equal to unity all universal constants that have no theoretical significance. The suggestion to make many of the n arbitrary choices in this way is very valuable; but it does not impose a unique set of choices. In particular, it does not force us to make either three or four arbitrary choices in a manner different from the remainder.

Two main errors are responsible for a failure to accept these certain conclusions. One is the ignoring of the distinction between what I have called A and B magnitudes, and of the fact that many magnitudes can be both A and B. The other is the belief, fostered by mathematicians, that experiment can establish the *equality* of magnitudes of different kinds; every experimentalist knows that it can only establish their *proportionality*.

I am expressing no opinion whatever concerning the practical convenience of Prof. Giorgi's system. I am protesting only against the view, apparently entertained by himself and his followers, that the number 4 has any greater factual significance in connexion with the choice of 'units' than the number 3, which used to be favoured.

NORMAN R. CAMPBELL.

[1] NATURE, 136, 71, July 13, 1935.

Points from Foregoing Letters

By means of their newly-devised supra-conducting galvanometer, Prof. E. F. Burton, F. G. A. Tarr and J. O. Wilhelm find that no thermo-electric current flows in a lead-tin couple if both junctions are kept below 3·7° K., when the metals are in the supra-conducting state.

The relation between the mass of the atomic nuclei of carbon and beryllium and the binding energy of their constituent alpha particles has been derived by Drs. H. S. W. Massey and C. B. O. Mohr.

The energy of the hardest known gamma rays (2·6 million electron-volts) obtained from ThC″ and supposedly from RaC can be related, Prof. G. J. Sizoo states, to the position of radioactive elements of odd charge, grouped according to their disintegration constants, plotted against the highest energy of the electrons (beta rays) they emit. The graphs show a simple relation between the two quantities in the case of elements of even and of odd charge number, and suggest that the hard gamma rays now ascribed to RaC may really be due to RaC″ and that similar radiation may be expected from UX_2 and AcC″.

New X-ray and electron-diffraction analyses of carbon tetrachloride vapour have been made by Messrs. Ch. Degard, J. Piérard and W. v. d. Grinten. Both methods give values for the interatomic distances in good agreement with recent electron-diffraction investigations. From microphotometer records of electron-diffraction photographs, the influence of thermal vibrations could be detected.

Drs. G. S. Carter and L. W. Mapson find that various sterols have an action similar to that of acetylcholine, weakening and slowing the beat of the frog's heart, but they nevertheless appear to balance one another's effects when present together. The addition of either a sterol or acetylcholine to the gastrocnemius muscle of a frog in the resting winter condition leads to prolonged contraction, but when added together, only a normal twitch is observed.

From the amount of vitamin C (ascorbic acid) extracted from a potato under various conditions, M. van Eekelen concludes that vegetables contain a ferment which partially oxidises the ascorbic acid and interferes with its titration. This effect may be eliminated by the addition of 3 per cent trichloracetic acid. The apparent increase in ascorbic acid observed by McHenry and Graham was due, according to Van Eekelen, to the destruction of the interfering oxidases and not to the liberation of more ascorbic acid from an ester.

E. J. W. Barrington reports the occurrence in the intestine and skin of the ammocœte larva of the brook-lamprey of a proteolytic enzyme apparently similar to that already known to exist in the ascidians. The alimentary systems of these forms are thus physiologically more closely akin than had been suggested by early work on the same subject.

Prof. E. C. C. Baly considers theoretically the velocity of activated chemical reactions brought about in two stages, such as those occurring in biological changes where an enzyme is adsorbed on a co-enzyme.

Drs. G. B. B. M. Sutherland and W. G. Penney point out difficulties in reconciliating the shape of the NO_2 molecule inferred from a study of the force fields of triatomic molecules with that deduced from the absorption of infra-red light, and suggest a re-examination of the contours of the absorption bands of NO_2.

Certain viscous materials like golden syrup run out continuously from an orifice while others like clay paste drop out in 'blobs'. Dr. R. K. Schofield and G. W. Scott Blair ascribe the difference to the rate of variation in viscosity with shearing stress, and direct attention to the importance of this factor in such practical matters as the 'shortness' of flour dough and the 'necking' and rupture of metal cylinders.

Research Items

Excavations at Tepe Gawra, Iraq

THE elimination of all but three archæological expeditions to Iraq through the working of the Antiquities Law would add interest to almost any find in the season which has just passed; but the excavations which have been carried out by the joint expedition of the Museum of the University of Pennsylvania and the American School of Oriental Research at Tepe Gawra are in themselves of too great importance to need extraneous enhancement. Mr. Charles Bache, field director, in a report circulated by Science Service, Washington, D.C., states that he has now reached the level of the twelfth city (counting from above) on the site. This he dates at about 4000 B.C. Exploratory trenches have revealed the existence of eight earlier levels. In the recently discovered twelfth city, which appears to have been destroyed by fire, no trace of metal was found, and it is concluded that the inhabitants were still in the neolithic stage. Its architecture is superior to that of the three cities immediately following. The pottery here, as well as in the eight succeeding, later levels, is of the 'painted' type. In a large building which has just been uncovered, the largest of the many rooms measures 37 ft. × 17 ft., a remarkable feature being that its mud-brick walls are coated with a fine white plaster. This is the earliest use of white plaster that has been discovered hitherto, and indicates knowledge of the process of burning lime. The fact that the walls of the room appear to be oriented to the cardinal points suggests a knowledge of astronomy. While no flat seals have been found, two impressions indicate their use.

Sex and Cultural Status

DR. J. D. UNWIN, in an address delivered to the Medical Section of the British Psychological Society in March last ("Sexual Regulations and Cultural Behaviour". Oxford University Press. Pp. 63. 2*s*. 6*d*. net), restates the argument for his view that opportunity for the satisfaction of the sexual impulse is related to the type or grade of culture of a society. Societies are classified according to their behaviour in relation to their objects of worship: 'deistic', when temples are erected to a god; 'manistic', when there are no temples, but acts of worship are performed at the graves of the powerful dead; and 'zooistic' when in times of difficulty offerings are placed before a "strange power". Each of these types of society has a characteristic form of sexual opportunity. Societies permitting pre-nuptial freedom are zooistic; those inflicting an occasional continence are manistic; while those insisting on a complete pre-nuptial continence are deistic. An analysis of social conditions on these lines indicates that there is a relation between sexual energy and social energy, the latter being a manifestation of certain inherent powers which remain potential except under conditions of continence. They are then released and the society becomes 'expansive'. In the past, sexual opportunity has been reduced to a minimum only with the introduction of absolute monogamy; and in human records there is no case of an absolutely monogamous society which has failed to display great energy. On the other hand, if the condition of absolute monogamy is relaxed, as usually has happened, the society loses its energy and power of expansion and passes from one grade to another, as happened in the Christian church, when, the regulations of continence being relaxed, it ceased to be purely deistic, and passed to the manistic stage with the introduction of the medieval cult of the saint.

Application of Vocational Guidance Methods

REPORT No. 6 of the National Institute of Industrial Psychology presents the results and methods of "A Vocational Guidance Research in Fife" carried out by F. M. Earle and J. Kilgour. The inquiry was designed to give comparisons between children in different stages of growth, by testing the same children at intervals with the same tests; to differentiate between children of urban and rural areas; to study the question of the best age at which vocational guidance studies should be begun; and to determine minimum standards of qualities of abilities and temperament desirable for various occupations. The investigation showed the town children to be superior in verbal ability, and the country children to be superior in non-verbal processes and practical activities. Interesting results concerning the consistency of test-scores from year to year are presented. Those of general intelligence show the highest consistency, but the tests of English and arithmetic gave comparable scores after a one-year interval, but not longer. In the case of mechanical ability the results suggested that it was of relatively late development, and could be measured more accurately between the ages of twelve and fourteen years than between ten and twelve years. Measures of mechanical ability were applicable at all ages, but reliable for short periods only. In view of these conclusions, the report recommends that there should be two stages in the application of vocational guidance methods; at the first the child should be tested before the age of twelve years with regard to recommendations for specialisation in later school work, and at the second stage, between the ages of twelve and fourteen years, he should be tested with regard to vocational recommendations.

Results of the Vernay-Lang Kalahari Expedition

THE freshwater fishes and the reptilia and amphibia are reported on by Henry W. Fowler and V. Fitzsimons respectively in vol. 16, pt. 2, of the *Annals of the Transvaal Museum* (Scientific Results of the Vernay-Lang Kalahari Expedition, March to September, 1930), February 1935. The fishes are very interesting, most of them showing a large range of variation, especially in colour. 900 specimens were secured, representing thirty species, of which twelve are new. The fishes from the Tsotsoroga Pan and from the Nata River are probably the first ever collected in these localities, those from the first having come originally from the Okovango inundations, the Nata River rising independently in Southern Rhodesia and running directly into Makarikari Lake, which is strongly brackish. Some of the fishes survive even in the larger brackish pools. The reptilia and

amphibia are not confined to the Kalahari, but include specimens from Bechuanaland Protectorate, Transvaal and Southern Rhodesia. They form a large collection of 1,452 specimens, belonging to 23 families and sub-families, 60 genera and 99 species and sub-species: tortoises and turtles, one crocodile, lizards, chameleons, snakes, frogs and toads. 18 new species and sub-species are fully described, preliminary diagnoses having been published already by the author. These include a *Kiniscys* and a *Pelusos*, a *Typhlops*, a *Chlorophis*, a *Psammophis* and a *Xenocalamus*, with several Lacertilia and Amphibia. Valuable field data are given, including breeding notes in many cases.

Life-History of a Nematode in Mice

B. SCHWARTZ and J. E. Alicata (*J. Wash. Acad. Sci.*, 25; 1935) describe the life-history of *Longistriata musculi*, a nematode parasitic in mice. The eggs hatch in about twenty-four hours after passing from the host, and the larvæ undergo one moult and are then infective to mice; these larvæ correspond in morphology and behaviour to third-stage larvæ of trichostrongyles in general. White mice were infected by the larvæ by way of the mouth and through the skin, and each portal of entry resulted in the worms reaching the small intestine, where they underwent their entire development, including two moults. The route from the skin to the intestine has not been ascertained; passage through the lungs was exceptional. In three white mice infected through the skin, egg-production by the worms was limited to about two weeks. Infection of two mice by way of the mouth resulted in a much greater output of eggs by the worms, which persisted as long as the mice survived, 32 and 63 days respectively, after the infection. It is suggested that the striking difference in egg-production by the worms in these two groups is probably due to a marked stimulation of the defence mechanism of the host coincident with the migration of the larvæ following infection through the skin. This stimulation is either lacking or not marked when the larvæ enter by way of the mouth.

Structure of *Drosophila*

THE fly *Drosophila melanogaster* has become one of the most widely used laboratory animals for genetical and other studies. The general structure of the creature, as distinct from the group of Diptera to which it belongs, has attracted comparatively little attention. This gap in the knowledge of *Drosophila* has been met to some extent by a recent publication by Mr. Eduard H. Strasburger. In a 60-page brochure, entitled "Drosophila melanogaster, Meig. Eine Einführung in den Bau und der Entwicklung" (Berlin: Julius Springer, 1935. 6.90 gold marks), he describes the general external and internal anatomy of the insect in its larval, pupal and adult phases, together with an account of metamorphosis and a very brief statement on the embryology. The work is illustrated by 71 text-figures and is accompanied by a short bibliography. It should prove useful as an introduction to its subject, especially to workers who are not specialists in entomology.

Sooty Mould Fungi

MISS LILIAN FRASER has made a study of the fungi causing sooty moulds (*Proc. Linn. Soc. New South Wales*, 58, Parts 5–6, 1933; 59, Parts 3 and 4, 1934). Sooty moulds are caused by several fungi, which together produce a dark brown or black felt of mycelium upon the leaves and branches of certain plants following attack by aphids. Miss Fraser's first paper shows that the fungi all belong to three groups—the Capnodiaceæ, Atichiaceæ, and Fungi Imperfecti. After a review of the species of sooty mould occurring in New South Wales, it became obvious that two main types appeared—annual and perennial. The former were constituted largely from mixtures of *Dematium*, *Cladosporium*, *Alternaria*, *Asbolisia* and *Triposporium*, whilst perennial moulds incorporated members of the Capnodiaceæ, *Atichia*, and a species from the Fungi Imperfecti. The second paper records a large number of results from cultural experiments with all types of sooty mould fungi. They are all shown to require different optimum concentrations of specific carbohydrates and nitrogen, and this fact may explain their distribution on plants attacked by woolly aphis or greenfly. 'Honey-dew' secreted by these insects consists of dextrin and other specific complex carbohydrates, along with protein material.

Chinese Loess Deposits

Observations by Prof. G. B. Barbour on the loess of North China (*Geograph. J.*, July 1935) clear up some points in regard to the nature and origin of the Chinese loess. The term loess has been employed to embrace three types of surface deposit. Loess accumulated during the Malan (Upper Pleistocene) stage of aggradation, which is generally unbedded, over much of the North China highlands rests on an older deposit having certain distinctive features. This deposit is more clayey and has a crude layer structure. The thick layers are more loessic in character, darker in colour and very like the upper Malan loess. It would appear that these layers represent a succession of soil horizons from which the soluble material was leached, and the arrangement suggests that deposition was interrupted by long intervals during which the surface was exposed to weathering. This series of deposits Prof. Barbour terms banded loessic loams. Still older is a series of red clays referred to the Pontian stage of the early Pliocene. These are associated with a less rugged topography than that of to-day. Chemical and mechanical analyses of the material showed that the æolian process was dominant in the deposition of the Malan loess and the banded loams. Prof. Barbour goes on to try to correlate these deposits with climatic changes. The general conclusions point to warm semi-arid conditions in the lower Pliocene, with increase of rainfall in the middle of the period and cooler and drier conditions at its close. At the end of the lower Pleistocene, a milder and damper climate (Choukoutien stage) was followed by the cold semi-arid Malan stage, which gave way to present conditions at the close of the Pleistocene.

Weather Cycles and Droughts

IN a paper read before the American Meteorological Society in June, Mr. Halbert P. Gillette attributes the recent severe drought in the United States to the coincidence of the minima of several long cycles of rainfall. The most marked of these is about 152 years in length, with an amplitude of 25 per cent; he finds this cycle not only in New England rainfall but also in the Nile floods, the tree rings of pine and *Sequoia* in Arizona and California, and the annual 'varves' or clay laminæ deposited during the

retreat of the last ice sheet in Canada. He considers that this cycle also determined the succession of halts and rapid retreats of the ice sheet in Finland. Judging by the evidence presented, the cycle of 152 years is probably real, and is important in geophysical phenomena; but the method of periodogram analysis adopted is not mathematically rigid, and the shorter cycles tabulated rarely agree with those found in meteorological data by more exact methods. A novel point is that each cycle is supposed to go through a 'cycle of amplitude' of many times its own length, that of the 152 year cycle being estimated as 1,825 years, but for the shorter cycles at least this apparently represents merely the 'beat' with the annual cycle.

A Recording Manometer

PAPER No. 91 published by the Safety in Mines Research Board is entitled "A Recording Manometer having Low Inertia", by G. Allsop and H. Lloyd. The principle of this manometer is the use of a thermionic valve connected to an oscillograph, which records the displacement of a small diaphragm exposed to transient pressures such as are produced by explosions. Various improvements on the original type are described, and it is shown that this manometer, with small variations, can also be used as a dynamometer. The appliance appears to be quite satisfactory, but is tolerably expensive, and is not likely to replace ordinary manometers for everyday work in mines, in which explosion pressures do not have to be measured. For measuring such transient pressures, especially where the cost of an appliance does not enter into the question, this ingenious manometer appears to be quite satisfactory.

Kiln-drying of Wood with Ozonised Air

THIS problem has recently been discussed by S. N. Kapur (*Indian For. Rec.*, **20**, Pt. 13. Delhi: Manager of Publications, 1935). The method consists in drying wood in an atmosphere containing small quantities of ozone, and is based on the assumption that the constituents of the wood during the long periods required for air-seasoning are subject to slow oxidative changes, which transform the sap contents chiefly—and according to some authorities the wood substance as well—into more stable compounds, thereby making the wood less liable to shrink and swell with changes in the humidity of the surrounding atmosphere, and consequently, more suitable for high-quality work. In summing up the results of his investigations, the author says that woods containing oils and oleoresins, which are difficult to 'kiln-dry', are in no way benefited by the addition of ozone to the circulating air in the kiln; that the addition of ozone to the air in the kiln does not accelerate the rate of drying of either resinous or non-resinous woods; and that timbers dried in an atmosphere of ozone, that is, 'artificially aged', do not show any greater stability towards changes of atmospheric humidity than those dried in a kiln without the addition of ozone.

Structure of Platinum Compounds

THE structure proposed for platinous compounds of the 4-covalent type [Pt a_2b_2] by Werner was that the valencies have a planar arrangement. A test of this, and a differentiation between a planar and a tetrahedral arrangement of valencies, is provided by substitution derivatives of bisethylenediaminoplatinous salts, [en_2 Pt] X_2. Diphenyldimethyl derivatives have been prepared by W. H. Mills and T. H. H. Quibell (*J. Chem. Soc.*, **839**; **1935**), and the optical activity of the compounds leaves little doubt that the planar configuration proposed by Werner is the correct one. The salts investigated proved capable of resolution into antimeric optically active forms showing a high degree of optical stability. The regular tetrahedral arrangement of valencies is excluded, and there are no reasons for inferring a pyramidal rather than the more symmetrical planar configuration. The planar arrangement of the platinum valencies with the intervalency angle of 90° is also shown to give rise to a practically strainless ring, whilst an arrangement with a tetrahedral valency angle would give rise to a very considerable strain in a 5-atom ring composed of carbon and nitrogen atoms and one 4-covalent platinum atom.

Einstein's Gravitational Equations

WE have received a very brief letter on this subject, dated June 2, from Prof. J. Ghosh; to make it intelligible to a wider range of readers it seems advisable to incorporate it with some references to Einstein's own work. The gravitational equations originally proposed, namely,

$$R_{im} - \tfrac{1}{2}g_{im}R = -8\pi T_{im},$$

represented a law of conservation such as that of momentum or mass and energy. Moreover, the left-hand side of the equation arose naturally in at least two mathematical processes. In spite of this, Einstein later (*Math. Ann.*, **97**, 99; 1927) gave electromagnetic and cosmological reasons for suggesting that the coefficient $\frac{1}{2}$ should be replaced by $\frac{1}{4}$. Prof. Ghosh (*Z. Phys.*, **85**, 511; 1933; and **94**, 411; 1935) has investigated the solutions of the new equation in four cases, corresponding to empty space, a single particle, an electron, and a rather more general system with radial symmetry. The results all contain a term belonging to de Sitter's world. Thus the new field equations automatically involve the cosmological constant, which is usually introduced as a special hypothesis. It is desirable that Prof. Ghosh's work should be extended to a more general distribution of masses, but this appears to be difficult.

Changes in the Spectrum of γ Cassiopeiæ

THE spectrum of γ Cassiopeiæ contains hydrogen lines each made up of double emission lines superimposed on a broad absorption line. Unlike many such stars, the spectrum had been considered to be always the same until recent observations by Dr. W. J. S. Lockyer showed that the two components of each of the double emission lines went through regular changes of relative intensity. This brought the star into line with other bright hydrogen line stars, most of which show similar changes. Later observations described by Dr. Lockyer (*Mon. Not. R.A.S.*, **95**, 520), however, show a most unusual type of change in these lines. The red component of each double had faded right out in March 1934, after which the remaining single emission lines (at that time forming the violet components) moved across to the position of red components, and in November new faint violet components appeared, the lines being again double, but with strong red and faint violet components. Such a change is believed to be unique in the history of such stars, and is difficult to explain by any of the current hypotheses.

Native Iron from West Greenland

By Sir Harold Carpenter, F.R.S.

THE structure and constitution of the native iron of Ovifak, Disco Island, West Greenland, have been the subject of controversy in the past, and in particular, uncertainty exists as to whether it does or does not possess the Widmanstätten structure which is characteristic of meteoric iron. By the kindness of Dr. L. J. Spencer, I have recently been enabled to investigate a sample which is contained in the collection of minerals in the Natural History Museum.

FIG. 1. × 75

FIG. 3. × 75

FIG. 2. × 75

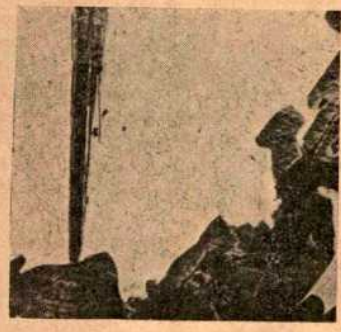

FIG. 5. × 75

FIG. 6. × 75

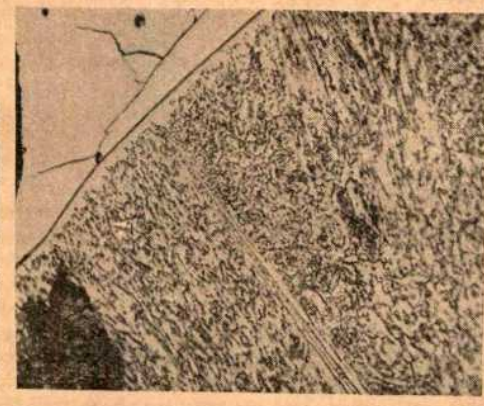

FIG. 4. × 750

The iron was found to be friable and somewhat oxidised. When crushed, it was seen to consist of grains of metallic matter which were apparently cemented together by basalt and oxidised material. As it was impossible to drill a sample, a piece of it was ground in a percussion mortar and after screening the powder the metallic matter was separated from the residue with a magnet and then analysed. The sample thus obtained was contaminated with a little oxidised material, but the results shown in the first line of the table below give a good approximation to the composition of the metal.

	Fe	Ni	C	Co	Cu	SiO_2	CO_2
Ovifak iron	93·9	2·50	1·63	0·98	0·21	0·24	nil
Mellor's analysis	95·15	2·55	3·11	0·93	0·48	4·18	
Meteoric iron	90·85	8·52	0·03	0·59	0·02		

The figures in the second line of the table represent the maximum percentage of the different elements reported in the analyses of the iron which have been carried out by numerous analysts (cf. Mellor, "Inorganic and Theoretical Chemistry", vol. 12, p. 522) while the figures in the third line represent the average of 318 analyses of meteoric iron calculated by O. C. Farrington (Mellor, p. 525). It will be seen that the carbon content of the Ovifak iron is greatly in excess of that found in meteoric iron, while its nickel content is considerably lower—in fact the maximum nickel content of this iron, namely, 2·55 per cent, is well below the minimum for meteoric iron, which according to Mellor is about 5 per cent.

A small piece broken from the sample was ground and polished for microscopic examination. When etched with 1 per cent nitric acid in alcohol, the structure was found to consist mainly of a massive white constituent in a finely divided duplex matrix, in which there were thin needles and bars which appeared to be of the same material as the white constituent (Fig. 1). Here and there in the specimen irregular white patches occurred, scattered through which were small particles that appeared to be of the same phase as the needles (Figs. 2 and 3). At high magnification the duplex constituent was resolved into a globular type of eutectoid structure (Fig. 4). When the specimen was etched with a

boiling solution of alkaline sodium picrate, the massive white constituent and the needles and bars were stained brown, thus proving them to be cementite (cf. Figs. 5 and 6, which represent the same areas as Figs. 1 and 3). The duplex matrix was very lightly etched, which is consistent with the view that it is the eutectoid of ferrite and cementite, and the irregular white patches appeared to be segregated areas of this mixture. Constitutionally, therefore, this 'iron' is a high-carbon nickel-cobalt steel.

The microstructure of the metal is altogether different from what would be found in an alloy of this composition which had solidified from the liquid state, and the question arises as to how it has been formed. The following view is accordingly put forward. The metal, which may originally have been carbonless, has been heated to a temperature probably in the neighbourhood of 900° C. in contact with carbon or more likely with carbon monoxide. This gas may have been produced by the combustion of lignite, beds of which occur on the island. Indeed it is possible that the metal has been produced from iron oxide which was first reduced by the gas to metallic iron and then carburised. The crystalline masses of cementite were formed in this way, but before the whole of the iron had been converted into the carbide, the temperature began to fall and the supply of carbon monoxide probably ceased, perhaps because of the exhaustion of the source of carbonaceous matter. At this point the alloy consisted of crystalline cementite and gamma iron saturated with carbon, that is, austenite containing more than 1 per cent carbon in solid solution. As the temperature fell, needles and bars of proeutectoid cementite crystallised from the austenite until the eutectoid temperature was reached, when the remaining austenite changed to the finely divided globular type of pearlite seen in the micrographs. The segregated areas may have been produced by slow coalescence of the cementite in the eutectoid during geological ages.

I wish to acknowledge the assistance of Mr. C. W. Dannatt and Dr. M. S. Fisher in this work.

Economics of Air Transport*

THE report on the Economics of Air Transport in Europe, recently submitted by M. Henri Bouchée to the special sub-committee of the Air Transport Co-operation Committee of the League of Nations, appointed to study the constitution and operation of a main network of permanent air routes, affords a dismal picture of the frustration of science. The report shows clearly that such free competition as exists in Europe to-day is chiefly competition in paying out subsidies. The waste and inefficiency in aviation which result from this commercial aviation are difficult to parallel. In the three years 1930–32, subsidies for aviation cost the European taxpayer about 2,000 million francs. Even in 1933, only four companies in Europe had advanced even half-way towards paying their way. At the end of 1932 British enterprises were nearly two thirds of the way, German enterprises only two fifths, French enterprises one fifth, Italian enterprises one fifteenth and air transport in Europe as a whole nearly one third.

In regard to actual use made of different air routes, the figures given in the report show the startling supremacy of the London-Paris air route, which in 1932 carried 5274 t. km. per km. of line, its nearest rivals being the Amsterdam-London route with 744 ton km. and the Paris-Amsterdam with 623 t. km. On certain routes, such as the Venice-Brindisi route, the figures are as low as 21 t. km., while financial returns indicate even more strikingly the supremacy of the London-Paris route, which shows more tonnes-kilometres utilised than the whole of the Belgian, Swiss, Czechoslovak, Polish, Swedish, Danish, Finnish, Austrian, Hungarian, Yugoslav and Roumanian services put together.

M. Bouchée points out that if the aircraft of Great Britain and of Finland carried a complete load, they would no longer need a subsidy, while the aircraft of the Netherlands would be independent if they were loaded to 75 per cent of their capacity. These figures prove that, from an economic point of view, certain lines are already operated very efficiently, and indicate that unsubsidised air transport in Europe is a matter of efficient technique and sound organisation. The obstacles to co-operation and efficiency are mainly political, and the relatively short distances flown in Europe will illustrate this point. They do not afford the decisive advantage which is possible in long-distance flights, and the system, as M. Bouchée remarks, is far more of the nature of propaganda than economic utility or the fulfilment of permanent needs. While surface traffic does not provide fast transport in Europe, the area is suitable for fast day-time flying, and that part of it which is most economically active will soon be a single territorial district which a fast aircraft will cross in half a day's day-time flying. The present services do little to meet the need for fast transport. Equally important is the question of giving air transport the freedom which is natural to it.

M. Bouchée calculates that, by rationalisation of European aviation, the whole of the present traffic could be carried with a quarter of the present European air fleet. Redundant or grossly uneconomic lines could be closed down and others at present non-existent could be set up. Air transport in Europe needs to be considered as a public utility service in the same way as the Postal Union or the International Sleeping Car Company, and the realities of the situation faced, so that aircraft no longer follow routes imposed on them or keep to Customs airports, 'corridors of approach' or 'prohibited zones'. The question, M. Bouchée concludes, is a political one. It cannot be solved merely by experts. Some form of internationalism is necessary if the present subsidies in Europe are to multiply direct and fast air services across territory better equipped and more freely accessible. In itself, the close co-operation essential might make a decisive contribution to the moral unity of Europe.

* Economics of Air Transport. By Henri Bouchée. Air Transport Co-operation Committee, League of Nations. (London: George Allen and Unwin Ltd., 1935).

International Conference on Folk Dancing

THE conference on folk dancing which formed part of the proceedings of the International (European) Folk Dance Festival, held in London on July 15–20 under the auspices of the English Folk Dance Society and the British National Committee on Folk Arts, met at Cecil Sharp House, Regent's Park, London, under the chairmanship of Prof. John L. Myres. One session was held at the Phœnix Theatre, Charing Cross Road, for the exhibition of cinematograph films and lantern slides illustrating the Morris and kindred dances and Dutch traditional dances.

The communications submitted to the conference numbered fifteen. It was thus possible, by adhering more or less closely to a fixed time-table, to allow ample opportunity for discussion and illustration by dance displays. The majority of the papers were concerned with the description of specific forms of national or regional dances; one by Mr. Rodney Gallop dealt with the principles and methods of recording folk dances, and the remainder discussed on broader lines questions of interpretation arising out of the comparative study of the dance as a popular mode of emotional and æsthetic expression among European peoples.

Of the communications of a more general character, that with which the conference opened, by Dr. Elise van der Ven Ten (Netherlands), on some aspects of the folk dance in various stages of the development of folk art, with the discussion which followed, was of importance for its clear-cut formulation of the relation between the scientific study of the folk dance and the revival of folk dancing as a means of individual, social and national expression. The author classified the folk dances of Europe according to the place they now fill in the life of the people, pointing out that while in eastern Europe they are still a living form of art, in central Europe they are dying, or even, as in modern Germany, have virtually become extinct; but in north-western Europe they are a revived art, largely owing to the work of Cecil Sharp (of which an account was given by Mr. Douglas Kennedy, director of the English Folk Dance Society, at a later stage of the conference).

It was laid down as a definite principle by Dr. van der Ven Ten and also by speakers in the discussion which followed the paper, that scientific study of the forms of the dance and its significance in the life of the folk is an essential condition of successful revival. Both in Germany and in Sweden, it was pointed out, such study had been found the essential preliminary in the revival of forms of the dance which would give full play to the development of individual and national consciousness.

Dr. Curt Sachs (Paris), in dealing with the symbolism of the dance, also stressed the importance in folk dance revival of study of the meaning or purpose of the primitive dance, which survives in the folk dance, although forgotten. The primitive dance, not being entirely æsthetic in origin, is on one hand a response to an internal physiological and psychological urge which raises the performer to an ecstatic magical plane, while externally its forms and associations with material symbols, such as the garland and the bridge, by mimicry or representation lead symbolically to a culmination in the promotion of fertility.

Among communications dealing with national or regional forms of the dance, such as that, for example, by Mlle. Louise Witzig (Zurich) on the Swiss folk dance and its significance in the revival of rural culture, and Prof. Césara Ehrenkreutz-Jedrzejewiczkowa on Polish wedding customs, reference was made to the reciprocal borrowing between court and peasantry. Such borrowing was also shown by Miss Violet Alford to have affected the character of the Morris dance. In her study of the Morris and the Morisca, she argued that before the Morris was affected by the fashion for the Moors, which was responsible for the dancers' black faces, and before the name 'Morisca', or 'Morris', was applied to it, it had once belonged to a pre-Christian European group of dances which were connected with a sacred animal.

An alternative view of the origin of the sword and stick dances, to which Miss Alford had referred, was put forward by Dr. Richard Wolfram (Vienna), who, elaborating from extended observation, especially in South Germany, a theory propounded four years ago, argued that these and associated 'chain dances' are a dramatisation of an initiation ceremony. He relied largely on the evidence of the association of such dances with secret societies; but, in the discussion which followed, reluctance was shown to accept his views as an exclusive or generally applicable interpretation, while a further obstacle to acceptance was the fact that there is no evidence in initiatory rites of the seasonal element inseparable from the sword and cognate dances.

Among the numerous points of interest which emerged from the communications of a more purely descriptive character, reference can be made here to one or two only—such, for example, as the relation between music, song and dance in Norway (Dr. O. M. Sandvik, Oslo), the primitive magic of the hobby horse of the Calušari of Rumania (Prof. R. Vuia, Cluj), and the taboos on partnership in the dance between certain individuals, varying with the stage of the proceedings, in the dances which accompany the wedding ceremonies of Poland, as described in the communication to which reference has been made above. A remarkable cycle of folk dances from Holland and the rites with which they are associated was shown in a cinematograph film by Dr. D. J. van der Ven. These ranged from children's processional customs to obsolescent dances now performed only by the older folk in keeping up the practices of their younger days, and to the living customs of the Harvest Home, or the midsummer bonfire and accompanying battle, or the remarkable and characteristic Dutch feat of 'flag waving', a combination of calisthenics and juggling, which on account of its associations with folk festivals, as well as its action, may well link up, as Dr. van der Ven maintains, with the fertility magic of the other peasant customs which he described.

South-Eastern Union of Scientific Societies

ANNUAL CONGRESS

THE fortieth annual congress of the South-Eastern Union of Scientific Societies was held at Bournemouth on June 26–29, under the presidency of Prof. A. C. Seward, Master of Downing College, Cambridge.

In his presidential address, Prof. Seward took as his subject "The Herbarium of the Rocks". He invited his audience to accompany him on a journey to a partially reconstructed forest of the Tertiary era. The Miocene Mascall flora of the John Day Basin of Oregon shows a close resemblance to that of the present-day Redwood Forest belt, although the former is many miles north of the latter. During the Oligocene period, Redwood forests very similar to those of California to-day have left traces in the Bridge Creek flora of the Crooked River Basin, south of the John Day Basin, and amongst other elements of this, for the most part dicotyledonous, flora is an Asiatic element showing relationship with Chinese plants. A similar flora to the Bridge Creek flora is found to have a wide range, since it occurs in Switzerland, Greenland, Siberia and Manchuria, but it is now confined to a narrow belt on the coast of California and Oregon. The Goschen flora of Upper Eocene times is another flora that differs widely from modern floras in corresponding latitudes. The view that these floras owe the members that they have in common to a southward migration of the parent plants from high northern latitudes has been confirmed in recent years. There must be a common origin for the similar living floras on both sides of the Pacific. Fifty-nine per cent of the genera of the Goschen flora are recorded from Cretaceous beds in the northern hemisphere where now is an arctic climate. Prof. Seward suggested that perhaps the Cretaceous ancestors of Tertiary plants were more tolerant of low temperatures. The ring of Tertiary floras that girdles the polar regions shows a decline of climate as compared with those of Cretaceous times. The Mull flora has much in common with that of arctic lands, and this with the other Tertiary flora represented by the inadequately-studied flora of Bournemouth show that there were then two distinct botanical provinces.

In the Archæological Section, Mr. T. D. Kendrick spoke on "Early Christian Art in the British Isles". Mr. J. B. Calkin demonstrated that prehistoric Bournemouth was full of interest. He has made a large collection of pottery and flint implements, which for want of a public museum are not available to the general public. His story of Bournemouth began with prehistoric man's implements found in the gravels between that town and Christchurch. Whilst there is no evidence of glacier conditions, the area was abnormally cold during parts of the Pleistocene era. Acheulean man lived here before the gravels were laid down, which were due to subsidence. At one time the area contained more than a hundred barrows. Few have been properly excavated, an exception being those of Hengistbury. Strangely enough, scarcely a single barrow faces Poole Harbour. Ten drinking beakers out of eighteen for the whole of Hampshire have been found in the district. Two food-vessels have come from Swanage, associated in each case with a human skull. In one Bronze Age site more than a hundred urns came to light, although most of them had been destroyed. An early Iron Age culture was found in Long Field, Hengistbury, corresponding with that of Hallstatt on the Continent. Mr. Calkin exhibited many of the remains to which he alluded in his paper.

Prof. R. J. Tabor and Prof. M. C. Potter read papers of a botanical nature. The Rev. F. C. R. Jourdain spoke on ornithological progress during the past fifty years, and commented on the new nomenclature that he and others were successful in bringing into effect, and on the increased study of bird-life as shown by the British Ornithologists' Union, now numbering more than 400 members, although it commenced in 1858 with twenty members. Some attention was given to the modern recognition of races of birds as well as species. "If the breeding ranges of two forms overlap or coincide and yet remain apart they must be species; if on the other hand they are obviously closely allied and yet replace one another geographically they are races." The hooded and carrion crows are distinguishable at a glance, and although they as a rule have different breeding ranges, there are places in Scotland, Germany and Russia where they interbreed. Mrs. K. Grant spoke on "Migration of Butterflies" and showed an exhibit from the entomological department at Rothamsted.

In the Geological Section, Dr. H. D. Thomas made out a good case for certain lines of evolution, or trends, in respect of fossil foraminifera and other lowly forms of life. A lecture by Lieut.-Colonel C. D. Drew on "Recent Excavations at Maiden Castle" was followed by a visit under his guidance by about seventy members to the earthworks. Here the cutting into the filled-up ditch, which had yielded neolithic evidence, was seen and also the remains of the Roman temple, round which were strewed innumerable roofing-tiles. Reference should be made to the small bronze bull which was found, with the upper parts of three human figures on its head and back; this was afterwards seen in the Dorchester Museum. In the museum was noticeable a large area covered with Roman tesselated pavement, laid down as originally on the floor of a Roman villa.

Dr. Vaughan Cornish gave one of his delightful talks on "Scenic Amenities in Town and Country".

Visits were made to Corfe, Littlesea, Beaulieu Abbey, Poole Pottery Works, Wareham, and other places of scientific interest, whilst on the social side of the Congress, the Mayor and Corporation gave the Union a civic reception at the Pavilion.

Educational Topics and Events

EDINBURGH.—Sir Charles Sherrington has been appointed Gifford lecturer for the years 1936–37 and 1937–38.

At the medical graduation ceremonial on July 17, the honorary degree of LL.D. was conferred on Prof. A. N. Richards, professor of pharmacology in the University of Pennsylvania.

LEEDS.—Mr. H. S. Clough has given £250 towards the erection of an observatory to house the telescope and other astronomical instruments recently presented by Mrs. Bolton of Bramley.

LONDON.—The following appointments have been made: Dr. James Whillis, since 1923 lecturer in anatomy at the College of Medicine, Newcastle-on-Tyne, to be reader in anatomy (Guy's Hospital Medical School) as from October 1; Dr. Jerzy Neyman, since 1927 lecturer in mathematical statistics at the Central College of Agriculture, Warsaw, and also since 1928 head of the Biometric Laboratory, Nencki Institute, Warsaw, to be reader in statistics (University College) as from October 1.

The title of professor of statistics in the University has been conferred on Dr. E. S. Pearson, in respect of the post held by him at University College.

The Sir George Jessel studentship in mathematics for 1935 has been awarded to Mr. A. E. Chapman, of University College.

Mr. E. P. Stibbe, senior demonstrator of anatomy at the London Hospital Medical College, has been appointed to the University readership in anatomy tenable at King's College from October 1.

PROF. A. NORMAN SHAW has been appointed head of the Physics Department and director of the Macdonald Physics Laboratories at McGill University, Montreal, in succession to Prof. A. S. Eve, who has retired.

A 'SABBATICAL YEAR' for university teachers is a notion that has obviously much to recommend it, but it has failed hitherto to gain effective acceptance in Great Britain as a feature of university policy. In a statement recently submitted on behalf of the Association of University Teachers to the University Grants Committee, it has been urged as a "highly desirable reform" and in an article by Mr. G. F. H. Harker, of University College, Cardiff, published in the April issue of the *Universities Review*, the case for it is argued with considerable force. The writer quotes Bertrand Russell's "Every university teacher ought to have one year in every seven to be spent in foreign universities . . ." and points to the spectacular rise of America to the front rank in so many fundamental branches of thought and action as attributable in some measure to American universities encouraging the members of their teaching staffs to do this very thing. English universities are more or less autonomous, and are proud of the fact, but they suffer, especially the smaller ones, from a correlative tendency to isolation. During vacations the average university teacher, except for spells of necessary relaxation, divides his time between private work for supplementing his income and the preparation of lecture courses for the ensuing session. Moreover, only a lengthy stay abroad, and that not during vacations, can give any real insight into universities in another country.

THE Tennessee Valley Authority has provided for the world an object lesson in the operation of a planned economy without recourse to compulsion. The salient features of this vast undertaking are already widely known in Great Britain thanks to the recent publication in *The Times* of special articles by Prof. Julian Huxley. An account of its more specifically educational aspects is given in *School Life* of March under the heading "A New Frontier in Education". The authority assumes towards its labour force responsibilities more like those of the head of a family than the mere cash nexus of the paymaster. It charges itself with the organisation of an environment suitable for a civilised life. In its various training programmes it has grappled successfully with the difficulties of providing ample facilities for instruction for employees without disorganising the work on which they are engaged. The normal working hours are 5½ hours a day for six days a week. For the more talented workers opportunity is provided for changing every five weeks from one to another of ten different types of work. The authority has created a civil service of its own in which appointments are, it is stated, made on the basis of merit only. This would-be Happy Valley covers 40,000 square miles and some six million people are or will be affected.

Science News a Century Ago

Death of Gilbert Thomas Burnett

ON July 27, 1835, at the early age of thirty-five years, Gilbert Thomas Burnett, the first professor of botany in King's College, London, died, worn out by "multiplied literary, lecturing and professional labours". The son of a London surgeon and born on April 15, 1800, Burnett began the study of medicine at fifteen years of age, and, after commencing practice as a surgeon, gave lectures on medical and general botany at the Great Windmill Street School of Medicine. He frequently lectured at the Royal Institution, gave a course at St. George's Hospital, and in 1831, on the opening of King's College, was appointed to the chair of botany. At the time of his death he was also professor of botany to the Apothecaries' Society. His "Outlines of Botany" in two volumes appeared shortly after his death, while a large series of "Illustrations of Useful Plants Employed in the Arts and Medicine", which was published during 1840–49 with drawings by his sister, contained text chiefly by Burnett himself.

J. D. Forbes in the Pyrenees

ANOTHER entry from the "Journal" of Forbes during his visit to the Pyrenees in 1835, dated July 29, said: "I left Luz on foot at half-past five, for Gavarnie. . . . Beyond Gèdre, where we breakfasted, I found in accordance with the accurate account of Charpentier, magnificent crystallised limestone in the granite: the granite here, like that of Héas, is altogether a strange rock, and often passes into a slaty structure, becoming gneiss, or mica slate, besides enclosing masses of these rocks, and forming an absolute breccia. But where crystalline, it seems to me never stratified; the fissures and the flat surfaces they leave can never be traced to any distance, and when they disappear, are as often at right angles to the former as not. The appearance of vertical stratification is often caused by the rain courses, as in the valley of the Reuss at St. Gothard, to some parts of which this valley has a great resemblance. . . ."

Berzelius in Paris

ON July 31, 1835, *The Times* announced that "The celebrated chymist M. de Berzelius has just arrived in Paris. He is accompanied by one of his former pupils M. Dahestraeno, professor of chymistry at Stockholm. It is the intention of these two *savans* to remain in Paris until the beginning of September, when they will set out for Germany, to be present at the meeting of the naturalists at Bonn."

Societies and Academies

PARIS

Academy of Sciences, June 12 (*C.R.*, 200, 1997–2044). HENRI DESLANDRES: A simple and general relation of the molecular spectrum to the electrons and rings of electrons of the constituent atoms. JEAN REY: The energy yield of thermo-compressors. The importance of its definition. DAVID WOLKOWITSCH: The conoid of Plucker. JEAN LERAY: The problems of conformal representation of Helmholtz: the theory of [ships'] wakes and bows. JEAN MARIANI: The general signification of the macroscopic theory of fields. A. A. GUNTZ and E. BELTRAN: The influence of H^+ ions in the phenomena of reduction and hydrogenation. The view is put forward that the attraction of the H^+ ions and the electrostatic repulsion of the nuclei suggests that the H^+ ions present in certain media may possess the property of preactivating a large number of molecules producing catalysis and syntheses. MLLE. SUZANNE VEIL: Contact batteries and the effect of short-circuiting them. MARCEL SERVIGNE: Some phenomena of cathodic phosphorescence. Comparison of the cathodic phosphorescence of precipitated and natural calcium tungstate (scheelite), showing the effect of the crystalline state and of the addition of traces of silver on the phenomenon. LÉON and EUGÈNE BLOCH: Research on the regularities of the Cu III spectrum. MARTIN BATTEGAY and EUGÈNE RIESZ: The di-anthraquinonylguanidines. JOSEPH WIEMANN: The synthesis and constitution of a dimethylhexite. ANTONIN LANQUINE: The relations of the Saint-Maximin (Var) Trias with the south-eastern termination of the Sainte-Victoire chain and with the eastern termination of the Olympe chain. ROBERT PERRET and JACQUES BOURCART: The lavas of Adrar and Asger. JACQUES FROMAGET: The discovery of new evidence of the upper marine Trias in the Haut-Laos synclinal. MLLE. HÉLÈNE ARLAUD: The Turonian of the neighbourhood of Cassis and the Cretacean movements in western Provence. MARCEL CORMIER: Hydrocyanic acid in *Pyrocydonia Winkleri*. Similar to the parent quince tree, the hybrid *Pyrocydonia Winkleri* furnishes hydrocyanic acid, existing in the plant in the state of heteroside. The proportion of hydrocyanic acid is about seven times that found in the parent quince. HENRI COLIN and HENRI BELVAL: The glucides of flour and dough. BASILE LUYET: Nuclear structure studied *in vivo* by the method of ultra-violet photography. The resolving power of the microscope can be about doubled by using ultra-violet light with quartz objectives with glycerol immersion. Chromatin is specially opaque to the ultra-violet rays, contrasting with the cytoplasm, which is much more transparent. The author has applied these facts to the study of the physical structure of the caryoplasm. SERGE TCHAKHOTINE: The localised flocculation of colloids in the cell by ultra-violet micropuncture. LOUIS COTONI and JACQUES POCHON: A new method of titrating antipneumococcic sera by neutralisation of the antibodies *in vitro*. ALFRED BOQUET and ROGER LAPORTE: Bail's phenomenon and tuberculin intoxication.

CAPE TOWN

Royal Society of South Africa, April 17. M. R. LEVYNS: Veld-burning experiments at Oakdale, Riversdale. These experiments have extended over five years and have been carried out on rhenosterveld. The results after burning differ from those previously obtained at Stellenbosch. There an immediate return to rhenosterveld was demonstrated. In this case the vegetation undergoes a series of successional changes before rhenosterveld is once more established.

May 15. F. G. CAWSTON: A second intermediary host for trematodes. J. V. L. RENNIE: On the flora of a high mountain in South-West Africa. In the higher parts of the Auas Range, near Windhoek, the thornveld is replaced by small shrubs, several of which might be interpreted as relics of an older flora in South-West Africa. *Passerina* and *Stoebe plumesa* are recorded for the first time from that territory. It has generally been assumed that the presence of certain Cape genera in East Africa and Angola is due to migration in former times via the eastern side of the subcontinent. The species here recorded suggest that at least certain elements of the Cape Flora could have reached the Huilla Plateau in Angola via a western route. A. GALLOWAY: Some prehistoric skeletal remains from the Natal coast. J. L. B. SMITH: The "Galjoen" fishes of South Africa. The Galjoen fishes are placed in a genus of somewhat doubtful taxonomic position. Owing to a combination of characters the institution of a new family (*Dichistiidae*) is proposed. E. E. GALPIN and E. A. GALPIN: Some biological notes on *Boscia rehmanniana*, Pest., and *Olea verrucosa*, Link. W. E. ISAAC and B. GERSHILL: The organic matter content and carbon-nitrogen ratios of some semi-arid soils of the Cape Province. The average C : N ratio for these, namely, 10·6 : 1, is contrasted with that of the winter-rainfall area (15 : 1). Decreasing organic matter content is accompanied by a decreasing C : N ratio. Although the organic matter of the semi-arid type of soil is low, the percentage of nitrogen in the organic matter itself is higher than for the winter-rainfall series. Hydrogen ion concentration figures show that the semi-arid type of soil is the more alkaline of the two. I. DONEN: The effect of time of picking on the chemical changes of Kelsey and Gaviota plums in store (read on March 20). Time of picking has no marked effect on chemical changes in the Gaviota plums. First appearance of bladderiness in all samples was noticed after about 44 days in store at 34°–36° F. Coincident with this breakdown a complete reversal of the sugar equilibrium was observed in the last two pickings. In the first two pickings of Kelsey plums, rate of loss of sugar was initially high and then declined rapidly to a minimum. In the last two pickings it remained uniform throughout the observed storage life. Internal browning of the tissue, accompanied by a reversal of sugar equilibrium, occurred sooner in the early pickings than in the later ones. Acid loss was high when sugar consumption was low and it is suggested that increase in rate of loss of acid is an 'overdraft' on stored acid due to insufficient supply of acid from oxidation of sugars. Low nitrogen and low acid therefore favour good keeping quality. This is correlated with delay in time of picking.

CRACOW

Polish Academy of Science and Letters, April 1. C. BIALOBRZESKI and I. ADAMCZEWSKI: The application of dielectric liquids to the study of the 'bursts' of ionisation caused by the cosmic rays. Compressed gas in the ionisation chamber is replaced by a liquid, such as hexane. The phenomenon is more distinct and more frequent. M. CENTNERSZWER and

T. CHECINSKI: Thermal dissociation of silver nitrite. Dissociation of silver nitrite can be represented by the equation $2AgNO_2 \rightleftharpoons Ag + AgNO_3 + NO$. The constants of the Nernst equation have been determined. M. BLUMENTHAL and T. CHECINSKI: Kinetics of the thermal dissociation of silver nitrite. A. SKAPSKI: Enunciation of the law of mass action in systems of one or several phases, especially from the point of view of the equilibrium of reactions in metallurgy. M. HLASKO and A. SALIT: Measurement of the electrolytic conductivity of extremely dilute solutions. Measurements can be carried out by the authors' method at dilutions down to 10^{-7} normal. The values thus directly obtained differ only by 0·1–0·2 per cent from the values obtained by Kohlrausch's extrapolation formula. The apparatus used in such measurements must be constructed entirely of quartz. K. DZIEWONSKI, K. BERNAKIEWICZ and W. MALICKI: The reactions of thiourea with the arylalkylketones. M. KSIAZKIEWICZ: The zone of the external Carpathian klippes in the neighbourhood of Andrychow. (3) The stratigraphy of the klippes and their position in the tectonic of the western Carpathians. T. WISNIEWSKI: *Hydrilla verticillata* of the lacustral region of Suwalki (northern Poland). T. WISNIEWSKI and MLLE. L. GOETZEN: The structure of the lamellæ of the leaves in European species of the genus *Polytrichum*. B. PAWLOWSKI: The final climax association of the Alpine stage of the Tatras. ST. MARKOWSKI: The influence of changes of the medium on the development of the eggs of *Bothriocephalus scorpii*. M. RAMULT: The embryonic and larval development of the crustacean *Sacculina* in media of different osmotic conditions. K. PASSOWICZ: Researches on the behaviour of the daphnid *Daphnia pulex*, Geer, in liquids of different hydrogen ion concentration.

May 6. K. DZIEWONSKI and L. STERNBACH: New studies on the reactions of benzoyl chloride on the aromatic amines and on their products, compounds derived from quinazoline. J. NOWAK: Origin of the flint in the Pleistocene of Volhynie. M. KAMIENSKI: Remarks on the Trojaga andesites. W. FRIEDBERG: *Turritella scalaria* and some remarks on gasteropods with unfolded testa. W. SZAFER and BR. JARON: A lake of Pleistocene age in the neighbourhood of Jaslo. MLLE. A. KOZLOWSKA: Characteristics of the forest associations of the mountainous region of the Cieszyn district. ST. JASNOWSKI: Inheritance of some characters of the ear of wheat. F. GORSKI: Gaseous exchanges in some submerged aquatic plants in the course of assimilation. Study of the gaseous exchanges of *Elodea canadensis*. About 30 per cent of the oxygen escapes as bubbles, the remainder dissolving in the water. The bubbles contain 50–60 per cent of nitrogen and about 1·5 per cent of carbon dioxide. MLLE. IRÈNE REJMENT: Contributions to the knowledge of the Hepatic flora in the sub-Carpathian region near Cieszyn. JAN TRELA: The interglacial period at Samostrzelniki near Grodno from the point of view of the results of pollen analysis. J. ZACWILICHOWSKI: The innervation of the hooking organs in *Argulus foliaceus*. F. ROGOZINSKI and ZB. GLOWCZYNSKI: (1) The nutritive value of Canary grass seed (*Phalaris canariensis*). (2) Irradiation and growth. With animals submitted to a complete and well-balanced food regime, irradiation by ultra-violet light has no influence on growth, but if the diet is defective, the light exerts a very marked favourable effect. MME. B. KONOPACKA: Histochemical researches on the development of fish. Vitellogenesis in the gudgeon and carp.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, July 28

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Plants".

THIRD INTERNATIONAL CONGRESS OF SOIL SCIENCE, July 30–August 7, to be held at Oxford. Sir John Russell: President.

Official Publications Received

Great Britain and Ireland

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1935. Pp. xii+77. Bulletin No. 40: The Management of Temporary Pasture. By W. M. Findlay. Pp. 8. (Aberdeen: North of Scotland College of Agriculture.)

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 17, 1934. Pp. iv+384+7 plates. (Sheffield: The University.) 7*s*. 6*d*.

Rothamsted Conferences. 19: The Production of Pigs for Bacon; being the Report of a Conference held at Rothamsted on March 6th, 1935, under the Chairmanship of John A. Fox. Contributions by J. B. Busby, J. Hammond, A. E. Law, H. R. Davidson, and others. Pp. 28. (Harpenden. Rothamsted Experimental Station.) 1*s*. 6*d*.

Second Greenwich Catalogue of Stars for 1925·0. (In 2 Parts.) Fundamental Stars and Stars in the Zone + 32°·0 to + 64°·0 from Observations with the Transit Circle made at the Royal Observatory, Greenwich, 1922–1930, under the direction of Sir Frank Dyson. Pp. xxii+257. (London: H.M. Stationery Office.) 17*s*. 6*d*. net.

Other Countries

Spisy vydávané Přírodovědeckou Fakultou, Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk.) Čís. 197: O difusních potenciálech, 2 (On the Diffusion Potentials, Part 2). Napsal V. Čupr. Pp. 14. Čís. 198. Výklad vznku netlumených kmitů mechanických (Über die Erregung von ungedampfen mechanischen Schwingungen). Napsal Josef Zahradníček. Pp. 18. Čís. 199: O některých nových nebo kritických rostlinách na slovensku a podkarpatské rusi (Plantæ slovakiæ et rossiæ subcarpaticæ novæ vel criticæ). Napsal Vlad. Krst. Pp. 16. Čís. 200: Hydrolysa Benzensulfonanů hlinitých (Hydrolysis of the Aluminium Benzenesulphonates). Napsali V. Čupr a B. Slíva. Pp. 13. Čís. 201: Příspěvky k mineralogii země moravskoslezské (Beiträge zur Mineralogie Mährens und Schlesiens). Napsal Jaroslav Kokta. Pp. 16. Čís. 202: Nové názory na stratigrafii křídy podještědské a podkrkonošské (Neue Ansichten über die Stratigraphie der Kreide am Fusse des Jeschken- und Riesengebirges). Napsal Břetislav Zahálka. Pp. 23. Čís. 203. Roční změny v působení oceanity na podnebí Československa (Parcours annuel de l'oceanité climatérique en Tchécoslovaquie). Napsal Bohuslav Hrudička. Pp. 15. Čís. 204: Regular Growth of Orthoclase and Quartz from Striegau in Prussian Silesia (Zakonný srůst orthoklasu a křemene od Striegau v Pruském Slezsku). By Miss B. Bobková. Pp. 18. Čís. 205: Sur une surface du sixième degré (O jisté ploše šestého stupně). Par Ladislav Seifert. Pp. 19. (Brno: A. Píša.)

Biologické spisy Vysoké Školy Zvěrolékařské, Brno (Publications biologiques de l'École des Hautes études vétérinaires.) Svazek 13, Spis 176–185. Pp. iii+166. (Brno. A. Píša.) 50 Kč.

Sborník vysoké Školy Zemědělské v Brně (Bulletin de l'Institut National agronomique). Sign. C29: Individuální nepřetržité měření zrna pšeničného a kukuřičného v destilované vodě a jejich fysikální změny. Napsali Prof. Dr. O. Kopecký a V. Almendinger. Pp. 52. Sign. C30: Vliv pineální žlázy na vývoj druhotných znaků pohlavních (Influence de la glande pinéale sur le développement des caractères sexuels secondaires). Napsal Dr. Jan Zahalka. Pp. 31+4 plates. (Brno: A. Píša.)

Zprávy komise na Přírodovědecký výzkum Moravy a Slezska. Oddělení geologické, Č. 12: Dodatky ke geologické mapě okolí olomouckého (speciální mapa č. 4153) a poznámky k některým listům sousedním (č. 4059, 4159, 4258, 4259). Napsal M. Remeš. Pp. 28. Oddělní zoologické, Č 21: Kuklice (Tachinidæ) Pavlovských kopců (Tachinaires des collines "Pavlovské kopce"). Napsal Dim. Jacentkovský. Pp. 13. (Brno: A Píša.)

Department of Public Instruction: Technical Education Branch, New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1934. Pp. 8. (Sydney: Government Printer.)

Catalogues

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 5, June. Pp. 55–68+iv+4 plates. (London: Wild-Barfield Electric Furnaces, Ltd.)

Chemical Pumps: Rotary Oil Air Pumps for use in Chemical, Bacteriological and Pharmacological Laboratories. (Prospectus No. 780a.) Pp. 6. (London: W. Edwards and Co.)

Cambridge Microtomes. (Folder No. 49.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

A Catalogue of Important Books on Botany from the Libraries of the late Lord Battersea, Miss Ellen Willmott, and other Recent Purchases. (No. 509.) Pp. 40. (London: Bernard Quaritch, Ltd.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON
Telephone Number:
WHITEHALL 8831

No. 3431 SATURDAY, AUGUST 3, 1935 Vol. 136

Problems of Industrial Hygiene

THE annual reports of the director of the International Labour Organisation cover an extensive field, all the more because the boundaries between social and economic questions have been largely obliterated by the recent economic depression. Hitherto, the main work of the Organisation has lain in the field of protective labour legislation. In this field its activities have already been of direct concern to professional workers, whether in science or elsewhere; and apart from the actual conventions already adopted by the International Labour Conference, a notable amount of research work has been carried out in subjects of direct interest to scientific workers, such, for example, as its studies on the operation of the radius clause, and the problem of the salaried inventor, industrial relations between staff and management, hours of work of professional workers, the status of engineers and chemists, and similar topics.

The extent to which an international labour code has been established has led to the suggestion that the goal of the legislative effort of the Organisation is in sight and that its remaining tasks are secondary. To the examination of this contention, Mr. H. B. Butler devotes a concluding chapter in his recent report (Geneva: International Labour Office, 1935) which is of particular interest to the scientific worker. At the outset, Mr. Butler rightly points out that social legislation is not static but dynamic. Already some of the conventions adopted are becoming out of date. Notably is this true of those bearing on questions of hours of work, in which the growing acceptance of the necessity for some further and wise distribution of employment or leisure is obviously a disturbing factor. Only as proposals are continuously put forward based on assiduous research can we hope to approximate to solutions of such problems which will offer the minimum of distress and the maximum satisfaction of man's needs. There are still important fields for scientific investigation which demand investigators of high quality. Such, for example, are the questions of training for industry, including vocational guidance, apprenticeship and technical education, and the many problems arising out of leisure and the provision of facilities for recreation which were discussed at an international conference at Brussels in June. Besides these, the special problems of the professional worker require fuller consideration, and the fields of industrial hygiene and safety offer an immense scope for future action.

Since the publication by the International Labour Office in 1928 of a report and a supplementary report giving a concise analysis of laws and regulations of all the great industrial countries, as well as a survey of the organisation and activities of safety associations in various countries, and the adoption at the Conference of June 1929 of a draft recommendation concerning the question of industrial accidents, the problems of industrial safety and hygiene have received a growing share of attention in Great Britain and elsewhere. Apart from the purely professional problems of the scientific worker, the work of the International Labour Organisation touches him at no point so closely as at this. Upon his co-operation the success of almost all its efforts in this field finally depends.

The prominence of these questions should not of course be wholly attributed to the influence of the International Labour Organisation. Quite

independently, the Association of British Chemical Manufacturers has already done a great deal to promote safety and hygiene in chemical industry by means of its model safety rules for chemical works, its safety circulars with their particulars of various accidents and their causes, its 'Safety Summary' of information on accidents and their prevention. The annual reports of H.M. Chief Inspector of Factories record the way in which such matters are receiving increased attention in industry generally, and the success of the Industrial Museum at Horseferry Road, Westminster, and the illustrated descriptions of industrial accidents issued quarterly by the Home Office, afford further evidence, if such be needed, of the widespread desire to make conditions in industry as safe and healthy as possible.

Whether we approach the subject from the point of view of the dissemination of information or of that of securing effective action, the part of the scientific worker is equally important. Both in the preparation of summaries or abstracts of safety information, or of such monographs as "Occupation and Health", issued by the International Labour Office, and in their use, his participation is essential if the information provided is first to be accurate and then to be used effectively. There is still need for much wider use and more effective co-ordination of available information, so that experience gained in one firm or industry at the expense of human suffering may be freely available to prevent a similar occurrence elsewhere. Few industries are served so efficiently in this matter as the chemical industry, and the very circulation of such a publication as the *Journal of Industrial Hygiene* indicates the need for development in this respect.

Again, the participation of scientific workers in the publication of notes on accidents and hazards, their cause and prevention might well be more widely encouraged. Much valuable work is being carried out by various firms, but not all of this is published and made generally available. Moreover, the whole field of industrial hygiene offers opportunities for research which are far from being fully explored. Much work of this type is pre-eminently suited for co-operative effort, and from this point of view the influence of the International Labour Organisation is highly important. While undoubtedly the actual investigations will best be carried out through national organisations, an international organisation can do much to delineate the problems and supply the stimulus where required, as well as secure co-ordination and avoid overlap.

Research work in industrial hygiene demands a high degree of co-operation between various classes of scientific and other professional workers. The annual reports of H.M. Chief Inspector of Factories afford continual evidence that failure to observe the provisions already laid down in the Factory Acts, and consequent industrial accidents, are due to the absence of skilled and qualified supervision, such as that of a chemist or engineer. Still more is it impossible to take adequate precautions and safety measures in the event of unforeseen contingencies, which can scarcely be entirely excluded from some processes or stages of development, in the absence of those who are able to bring a trained mind and expert knowledge to bear on any emergency.

There are welcome signs that this responsibility is now widely recognised among scientific workers, and that those occupying positions of responsibility are resolved to do all in their power to guard the worker in industry from risks of which he is often unaware and which only the scientific worker can appreciate. Certain professional organisations, such as the British Association of Chemists, have set themselves definite aims in this matter, and the Association of British Chemical Manufacturers is already carrying out a large amount of valuable work. The proposals of the new Poison Rules in regard to the supervision of the manufacture of pharmaceutical preparations will certainly be closely scrutinised from this point of view.

There are, however, many industries where a great deal more remains to be done, where scientific and professional workers are isolated and few in number. To raise the standard of industrial hygiene and safety in such industries demands all the support which they can receive from their professional and scientific colleagues and from the investigations and general efforts of such organisations as the International Labour Office. Only as the technical staffs are inspired by the consciousness of high professional traditions and solidarity in this matter of industrial safety, and as the work of the factory inspectors is continually reinforced by educational and research work stimulated by an international organisation pooling knowledge for the common benefit, can we hope to see the minimum standards of the law exchanged for those guaranteeing the maximum security of life and health.

Kenya: The Settler's Story

White Man's Country: Lord Delamere and the Making of Kenya
By Elspeth Huxley. Vol. 1: 1870–1914. Pp. xiii + 315 + 12 plates. Vol. 2: 1914–1931. Pp. vii + 333 + 12 plates. (London: Macmillan and Co., Ltd., 1935.) 2 vols., 25*s*. net.

THE author of this most interesting book is the daughter of a Kenya settler, reared and educated in Kenya. It is perhaps the most comprehensive account of the pioneer activities in farming and politics of European colonisation of those highlands in east equatorial Africa that has yet appeared. It is written round the life of that father of his adopted country, Lord Delamere, the ablest and most intelligent leader that the settlers have produced.

Kenya has, in the forty years of its history under British administration, been the centre of acute controversies, all of them raising issues that have reached far beyond its frontiers, affecting race relations and Imperial policy throughout the whole world. Kenya, owing to its geographical position, its unique climate, and the curious make-up of its very varied population, has always been, and will always remain, the focus, if not the storm centre, of a complex of difficult problems. It is not a normal land, and, like Ireland, it excites a romantic and even an emotional sentiment of intense affection, or intense antipathy, in all who have anything to do with it. That people 'fall in love' with Kenya is not surprising. The admirable photographs in this book will give some idea of the attraction of its spaciousness and beauty.

It has been said that Kenya is inhabited by the most difficult Europeans, the most difficult Indians, and the most difficult African natives in the Empire, all seeking livelihood in what is economically, and, from the point of view of the human species and his domestic animals, a most difficult country to harness to man's use. That the fair highlands of Kenya were so sparsely populated when less than forty years ago Europeans began, with official encouragement, to colonise it, was not due solely to the warlike proclivities of the nomadic Masai. Almost every known form of mycological, protozoan, helminthic and insect pest formed the flaming swords of death that guarded and still guard an apparent garden of Eden. Wheat rust, malaria, red water fever, rindepest, worm-infested herds of zebra, tsetse fly, and last but not least, swarms of locust of more than one variety contend with man for the domination of the land; and the fight is not won yet.

Lord Delamere was a romantic figure, part politician, part farmer and part Puck. Born in 1870, the only son of the second Lord Delamere, he was taken away from Eton at the age of sixteen, and, at seventeen, succeeded to the title and responsibilities of a feudal family estate in Cheshire. Civilisation, and the accidents of his birth and circumstances in England, for a young man of his temperament, were soon found to be constricting, and early he sought to escape from their toils. At the age of twenty-five he wandered through the port of Zeilah, that has recently become famous on account of the Italo-Abyssinian controversy, and through the semi-arid hinterland of Somali country into the country round Mount Kenya, and thereafter he devoted his remaining thirty-six years of life whole-heartedly to Kenya. His patrimony in England became but the milch cow from which the last possible drop was extracted for financing his very varied pioneer experiments in Kenya. Family, financial interest or motive, comfort, everything in life, he sacrificed on the altar of his passion for the colony.

By inheritance and upbringing, Lord Delamere was an eighteenth century aristocrat for whom there were three proper occupations—sport, agriculture and politics. But to inheritance and upbringing was added a personal individuality such as was possessed by the pioneer explorers of history, coupled with a very penetrating, if impish, intelligence, and a natural liking for and understanding of the African native, especially of the more primitive tribes. His personal handling of his favourite Masai in the troublous times of the War stands out as perhaps his most remarkable achievement.

Lord Delamere had inevitably an almost complete disregard of money and economics. He was recklessly generous and grandiose as regards the former. For himself, he lived hard and simply, but in his pioneer experiments in new agricultural introductions he was lavish, and the few successes had to compensate the bankers responsible for his overdrafts for many inevitable failures. The end of scientific experiment had to justify the means. Like many another English country gentleman who devotes his energy and substance to the tradition of agriculture, he always hoped but never really expected that the 'Home' farm would pay! Though Kenya owes a tremendous debt to Delamere for his farming experiments—

wheat, the introduction of Merino sheep, pedigree cattle, all of which he was the first to try out—it is not as an agriculturist but as a man of affairs that he made his greatest contribution.

Mrs. Huxley has given us on page 88 of the second volume the following admirable description:

"On many matters Delamere's advice was of great value to the Government. It was easier to deal with a man of his calibre than with eleven discordant elected members. He was willing to help as well as to harry. But he could be a dangerous opponent. He was always on the alert. Outwardly he was urbane, charming and courteous; ready, at any conference or interview, to voice an opinion in the most conciliatory, almost deprecating, fashion. But little escaped him; and at the first error of fact or flaw in argument he would pounce quickly, still with unruffled courtesy, his blue eyes twinkling as he puffed a large cigar, his head cocked on one side like a sparrow. On occasions he had a keen appreciation of the dramatic effect of sudden outbursts of temper, to be followed by a complete withdrawal and an apology so charmingly delivered that offence had to be forgotten."

This is an almost perfect picture of the man, whose sense of humour was never failing and whose mental resource was like a rapier. He did not suffer fools—especially official fools—gladly, and, like an African native he was a quick judge of both character and wits Everyone official and unofficial knew that he was by ability and experience the outstanding figure in Kenya. Most people, especially his own native personal servants, loved him. A few people hated him.

Mrs. Huxley has written a faithful story of his adventurous life, and it needed to be told as she has told it. Of course, Delamere was the centre of all the storms and escapades of Kenya's eventful history. She has inevitably written of the controversies from the settlers' point of view. She is not always quite fair to the poor old Colonial Office, thousands of miles away in Downing Street. She is fully aware that the pro-Indian and pro-native enthusiasts have hitherto had most of the publicity, and she has fearlessly entered the lists. Her book is not always strictly impartial or objective, and doubtless it is the more stimulating and readable for that reason. Occasionally guilty of *suppressio veri*, she is very rarely, if ever, guilty of *suggestio falsi*. The book is remarkably free from any errors of fact—but, on page 224 of the second volume, Sir George Schuster, who had been financial adviser in the Sudan, was then financial adviser to the Colonial Office, and was later to become Finance Member of the Viceroy's Council, is wrongly described as an Indian Civil Servant.

The book contains all the essential quotations from official sources as to the origin and development of the official policy of European settlement, and from the all too numerous Commissions which have wrestled with constitutional problems in East Africa. It is cleverly and attractively written, and admirably produced. On page 83 of the first volume, Mrs. Huxley has penetrated very deep into the root causes of our Imperial difficulties over Kenya.

"This loss of faith is perhaps", she writes, "at the root of the misunderstanding and the bitterness that has grown up, since the war, between the settlers and their English rulers. For the colonists have in the main retained their old philosophy and preserved their faith. Economically they have believed, blindly like all producers, that the time will come when more raw materials will be needed. The intellectual isolation of colonial life has to a large extent cut them off from the influences which have brought about a change of philosophy in England. . . . To the gulf of distance, therefore, between the settler and the British voter who rules him, has been added a still deeper and more difficult gulf—the gulf of outlook. The colonist does not realise why the Englishman has apparently lost all sympathy with him. Inwardly he feels betrayed. The Englishman does not see that the colonist is guilty not of oppression but of consistency. So the settler stands marooned, cut off by the tide of post-war disillusion from the shore which he so confidently left, and gazing with a puzzled and aggrieved expression at the unfamiliar and defeatist sea."

This is a true picture of what all too many settlers feel, not in Kenya only. But, while it is true that for economic and political, and even deeper reasons, there has been a great and subtle change in English views on racial questions, it is wrong to describe this new attitude as one of 'defeatism'. It is by no means certain whether it is not the 'die-hard' who is the more guilty of defeatism, than the man who adjusts his point of view and his methods to an ever-changing world, and retains his faith in the ideals of British freedom, initiative and adaptability, finding new methods—often merely new forms and phrases—to continue that leadership and influence which will carry us even further to success as the people who have shown the greatest genius for colonisation in human history. The die-hard is the defeatist because he thinks we can only succeed on the basis of the old pre-War conditions, and in the pre-War environment. Nobody so young and so intelligent as Mrs. Huxley need really despair of our Imperial future.

W. ORMSBY-GORE.

Atmospheric Physics

Vorlesungen über Physik der Atmosphäre
Von Prof. Alfred Wegener und Prof. Kurt Wegener. Pp. xii+482. (Leipzig: Johann Ambrosius Barth, 1935.) 36 gold marks.

IN 1911 there appeared an attractive and highly individual book by Alfred Wegener, entitled "Thermodynamik der Atmosphäre". Under this somewhat forbidding title a wide range of atmospheric topics was discussed, with originality and insight if not always with adequate critical judgment. The book met with a favourable response, and was reprinted without alteration in 1924 and 1928, circumstances preventing the author from making the changes and extensions called for by the advance of knowledge. Meanwhile Wegener achieved world-wide fame as the author of the hypothesis of continental drift, which he expounded in a well-known and much discussed book; he also led a number of scientific expeditions, and unfortunately, in the last of these, to Greenland, he met his death.

Wegener had planned to expand his "Thermodynamik der Atmosphäre" into a more comprehensive book on the physics of the atmosphere, and among his papers the preface to this proposed work was found, of date 1928–29; it is a modest statement of his aim to produce not a detailed treatise but an introduction to the subject, individual in outlook. His brother, Kurt Wegener, who took up the leadership of the ill-fated Greenland expedition and published its results, undertook also, as a pious obligation to his brother's memory, to execute the transformation of the "Thermodynamik" into a "Physik der Atmosphäre".

This book is now issued, under the joint names of the two brothers. The author has evidently found the writing of the book a long and arduous task, as is really inevitable from its wide scope. Much of the original work is retained, including about half of the 143 illustrations in the original, supplemented with others to a total of 192 in the new book; the old illustrations, many of them very attractive pictures of clouds, waterspouts and other such phenomena, are indeed better reproduced now than before. The old material has, however, been much rearranged, and the original book is increased in size by about fifty per cent (from 331 to 481 pages) by the addition of new matter.

The new material includes a lengthy account—of about 35 pages—of the Milankovitch theory of solar radiation in the earth's atmosphere, and extended treatment of friction (eddy viscosity) atmospheric optics, atmospheric electricity and other topics. The author in his preface expresses his dissatisfaction with the chapters on radiation and on friction: the inclusion of the theory of Milankovitch in the former chapter certainly seems out of line with the general plan of the book, which is elsewhere substantially non-mathematical.

The task which the author has attempted is one of considerable difficulty, and perhaps one not intrinsically congenial, being undertaken mainly out of respect and affection for the memory of a brother. It is therefore with both sympathy and regret that the reviewer feels constrained to express an adverse opinion on the execution of the task; the more so since the book shows a commendable lack of national bias in its choice of matter and of references to authors. The inadequacy of the book in its new form lies in its undue retention of old points of view, and the lack of mention of very much new work done since 1911. It is true that there are a few references of very recent date, including the 1934 paper of Götz, Meetham and Dobson on the mean height of the ozone layer; but the author does not seem really familiar with several of the advances made in atmospheric physics during the last quarter century. A few illustrations of these statements may be cited.

One of the individual peculiarities of Alfred Wegener's "Thermodynamik" was his postulation of a hypothetical element, geocoronium, as constituting, with hydrogen, the upper layers of the atmosphere, from about 100 km. upwards; an atomic weight of 0·4 was suggested for this element—a value which the subsequent progress of physics has wholly ruled out. It is astonishing to find A. Wegener's original height-composition diagram, including this element, reproduced in 1935, even though the anachronism is mitigated by the (inadmissible) suggestion that geocoronium may now be identifiable as electron gas, or may not exist at all. The few pages of discussion of the composition, pressure and temperature of the atmosphere at great heights are in part incorrect, and generally inadequate. The works of Jeans, Milne and Lennard-Jones on the escape of atmospheres, and those of Lindemann and Dobson on the temperature as indicated by meteor observations, are not mentioned; nor is the possibility, now widely favoured, that mixing keeps the composition uniform up to about 100 km. (except as

regards water and ozone). The few pages devoted to planetary atmospheres are also rendered out of date by later work of Slipher, Russell, and of the Mount Wilson Observatory.

Similar criticisms may be made of the treatment of the auroræ and of iridescent and of luminous night clouds. Størmer's recent important work on these two types of high cloud, in which he has measured their height and motion by the methods long successfully applied to the aurora, is not cited: nor is his important discovery that very high auroræ lie in the high sunlit region of the atmosphere. The account of the present state of knowledge as regards the auroral spectrum is likewise unsatisfactory.

Turning to the more generally studied fields of meteorology, examination of the chapters on the mechanics of the atmosphere, in which air waves and clouds of wave-like form are discussed, shows that the Helmholtz theory of these clouds is described, without reference to the work of Rayleigh, Bénard, Idrac and G. T. Walker and his school, on vortical and shear motion in unstable layers of fluid; yet this work seems to offer a more satisfying explanation of a wide variety of cloud forms.

The chapter on radiation, which contains a long account of the theory of Milankovitch, makes no reference to the important work of Simpson, based on Hettner's study of the spectrum of water vapour; likewise the work on lightning, due to Simpson, C. T. R. Wilson and, in Africa, by Schonland, is not cited in the chapters on atmospheric electricity. It is, of course, impossible to deal in detail with a wide variety of topics in a book of this size, but to the reviewer it seems that some brief account of such recent advances should have taken the place of out-of-date or less important matter that is included.

This general criticism can be illustrated also by the results of an examination of the author's index. The name of Fabry, for example, is naturally looked for, not least on account of his very important work on atmospheric ozone: the one reference to his name is found, however, to be to a determination by Fabry and Perot of the viscosity of air—for which, surely, the most recent value, taken from one or other of the most modern tables of physical constants, should have been cited. Perhaps the strangest feature of the name index, however, is that Isaac Newton is quoted only as the author of the notation $\dot{x}$ for Leibniz's dx/dt, while his formula for the velocity of sound, and his law of friction, are attributed to H. A. Newton, a writer on meteors! The date of the latest reference to meteors seems, by the way, to be 1893.

These illustrations of points of criticism necessarily refer only to a fraction of the book; but they seem to the reviewer to be too typical of the whole. The high purchase price might certainly be laid out to better advantage by seekers after knowledge of atmospheric physics.

S. CHAPMAN.

Through Einstein's Eyes

The World as I see It
By Albert Einstein. Translated by Alan Harris. Pp. x+214. (London: John Lane, The Bodley Head, Ltd., 1935.) 8*s*. 6*d*. net.

THIS book ought to be entitled 'The World as I feel It', so suffused is it with a deep sincerity and a passion for justice. To Einstein the world is a painful place, not merely because of the suffering that abounds but also because of the latent possibilities for good that man creates and ignores. Jews are persecuted, driven and hunted from the lands of their adoption to which they have contributed so generously in art, in science and in literature. Einstein sees the dignity of civilised human beings humiliated, and their bodies physically maltreated for their political views or racial descent, and as a sensitive human being he suffers with them in shame. Art slips into decadence, science is circumscribed, political leaders lose their independence of spirit and the ordinary citizen his sense of justice. Masses, worked into fury by unscrupulous newspapers, don uniforms to kill or be killed for worthless aims, and nations arm for war on a colossal scale, while their leaders chatter of peace. All this Einstein sees and it tortures him.

Whatever coherence this book possesses is of an emotional or an aesthetic nature; no attempt is made by the distinguished author to construct a consistent sociological background against which to view the multitude of problems that arise on every page. He stresses the contradiction in social organisation, that machinery should intensify rather than moderate the struggle for existence, that science should be used for war and destruction, and he pleads for a planned subdivision of labour as the solution. Coupled with this he would make a call to the economically stronger members of

the community to arrest the threatening decay of scientific life; but there is no discussion of the obstacles in the way of such a simple solution. It is an emotional rather than an intellectual analysis. Such questions occupy four of the five parts into which the book is divided.

It is in the last part that Einstein turns to matters more specifically scientific. Here he discourses very briefly on a variety of methodological and philosophical topics: scientific truth, methods of theoretical physics, various aspects of relativity; Kepler, Newton, Clerk Maxwell, Bohr, Planck, and many others. Many parts of it were delivered as lectures to various bodies. Here again the transparent sincerity of the man shines through everything he writes.

Experience, according to Einstein, is the alpha and omega of all our *knowledge* of existence, but the reasoning mind makes its specific contribution in the logic of science, and that contribution lies in the basic concepts of mechanics. Every attempt at a logical deduction of these basic concepts from elementary experience, he argues, must be doomed to failure; they are creations of the imagination, not given realities. Pure thought nevertheless can grasp reality, but in the last resort experience must always remain the sole criterion of the utility of any such mathematical construction. The mind grasps this reality that exists outside it, and creates in addition basic concept by means of which it organises and understands that experience. The mind is thus a creative force in Nature, but there must exist an external reality upon which it must operate.

The treatment at this level would have been complete, in broad outline at any rate, had Einstein recognised the significance of the question suggested by the evolutionary outlook, namely, how far the mind of man is itself restricted and conditioned historically by the objective world, and thus how far the validity of the logic of science is affected by the fact that the reasoning capacities of man, although presumably ever-sharpening are nevertheless never perfect. In this way would the problem have been raised whether these basic mechanical concepts that serve in science to unify experience are indeed 'free' creations of the imagination.

H. L.

Ideal and Real Crystals

Ideal- und Realkristall
(Sonderheft der Zeitschrift für Kristallographie, Band 89, Heft 3–4.) Pp. 193–416. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 17.60 gold marks.

WHEN one of the editors of the *Zeitschrift für Kristallographie* received almost simultaneously two papers on the above subject, it occurred to him that a valuable opportunity had arisen of securing an adequate review and discussion of this important topic by devoting to it a separate issue of the *Zeitschrift*. As a sequel to this happy inspiration, a double-number has now appeared, which contains an introduction by Prof. Niggli himself, followed by thirteen papers and one shorter note on the same subject. The papers are all printed in the language in which they were written, with the result that half of them are in English and half in German.

The series of papers opens with an important contribution by Prof. Buerger, from the Massachusetts Institute of Technology, on "The Lineage Structure of Crystals", in which he demonstrates the widespread occurrence of a phenomenon analogous to dendritic or arboraceous growth, giving rise in massive crystals to a structure which appears as a 'mosaic' when viewed only in two dimensions, but is often a complex three-dimensional structure of nearly parallel branches springing from a single stock or nucleus. The impression thus created, that crystal structures are predominantly tangled, is happily corrected by a final brief note by Dr. Buckley, from Prof. W. L. Bragg's laboratory in Manchester, in which he shows that crystals of potassium sulphate, grown in a thermostat in presence of a dye-stuff, and allowed to dry without the assistance of filter or blotting paper, can be obtained in a state of such perfection that magnificent interference patterns between parallel faces can be observed with monochromatic light. Many other examples of a similar character are cited, and it is clear that the imperfections, which formed the original subject of discussion, are far from being universal, and that real crystals can in fact approach very nearly to the ideal.

Limitations of space forbid any reference to the other papers of the series, but it is to be hoped that the unfavourable rate of exchange, which increases the price to English readers to about thirty shillings, will not prevent them from being widely read and studied in Great Britain.

T. M. L.

Paläogeographie: mit besonderer Rücksicht auf die Fehlerquellen
Von Dr. Fritz Kerner-Marilaun. Pp. viii+410. (Berlin: Gebrüder Borntraeger, 1934.) 30 gold marks.

As palæogeography is a composite science which serves to co-ordinate stratigraphy, palæontology and tectonic geology, the palæogeographer must be conversant, not only with the aims and methods of these branches of geology but also with the possible sources of error which may arise. We already possess several excellent standard treatises on palæogeography, such as the classical works of Arldt and Dacque, which follow more or less conventional lines. The author of the present book, however, approaches his subject from an entirely different point of view by discussing the problems with special reference to the possible sources of error.

The book is divided into four parts. Part 1 deals with the sedimentary rocks and the criteria to be applied in determining the conditions under which they were formed. It provides an up-to-date discussion of the problems of sedimentation, and a most instructive section is that dealing with the many errors possible in the recognition of desert deposits. Part 2 is devoted to correlation and the use of fossils both in the correlation of beds and in the determination of sedimentary environment. Part 3 is a modern presentation of the various theories of mountain building, including a discussion of Wegener's theory of continental drift.

Part 4 includes about one third of the entire book and is devoted to palæocartography. The author here stresses the importance of distinguishing clearly between palæogeographic investigations in unmoved areas in which the palæogeographic lines can be projected, without error, on to the present maps, and investigations in areas which have suffered lateral translation by folding or thrusting. In the first case the sedimentary rocks occur in the areas in which they were originally deposited but, in the second case, their original regions of deposition lie at a greater or lesser distance from their present position. This movement factor is one which often escapes recognition, and the author has performed a great service in directing attention to it.

Altogether the book should prove of great use and value to geologists working in many different fields, but it is of an advanced nature more suited to the needs of the research worker than those of the student.

The Handbook of Palestine and Trans-Jordan
Edited by Sir Harry Luke and Edward Keith-Roach. Third edition. Pp. xvi+549+1 map. (London: Macmillan and Co., Ltd., 1934.) 16*s*. net.

CONDITIONS change with such rapidity in modern Palestine that it is not surprising that very considerable revision has been necessary in the preparation of the new edition of "The Handbook of Palestine and Trans-Jordan". Information and statistics have been brought up to date, and, to quote Sir Arthur Wauchope's introduction, it now "gives a full account not only of the country's past, but of the achievements and changes of the last four years".

In view of the interest of Palestine's prehistory, it is a pity that the section dealing with this subject has not been more adequately revised. Miss Garrod's more recent discoveries are not completely covered, though, presumably, the final revision of the text had not been made before some, at least, were available for inclusion, while Sir Flinders Petrie's work in the neighbourhood of Gaza is barely mentioned. The important results obtained at Tell Duweir do not appear at all. Hence the largest Tell of archæological importance in Palestine does not appear on the map, while its identification with Lachish, now certain, entails correction of both map and text.

These, however, are perhaps minor blemishes, where so much ground is more than satisfactorily covered. The handbook continues to be a never-failing source of information on the geography, history and social and economic conditions of the country.

Hutchinson's Technical and Scientific Encyclopædia: Terms, Processes, Data, in Pure and Applied Science, Construction and Engineering, the Principal Manufacturing Industries, the Skilled Trades; with a Working Bibliography, naming Three Thousand Books and other Sources of Information, under Subjects. Edited by C. F. Tweney and I. P. Shirshov. In 3 vols. Vol. 2: Direction of Rotation to Hydrogen-Ion Concentration. Pp. ii+673–1344. (London: Hutchinson and Co. (Publishers), Ltd., 1935.) 28*s*.

MUCH credit is due to the editors of this "Encyclopædia" for the design and execution of their work. So many subjects may be regarded as "technical and scientific" that to endeavour to afford appropriate information upon all matters pertaining to them, not only for scientific workers and technologists, but also for intelligent inquirers among the general public, would seem almost an impossible task. So far, however, as is practicable within the limits of three volumes, and judging by the contents of the two volumes already published, the editors will achieve their purpose. In the present volume, for example, sixty-seven pages are devoted to electrical subjects from "Electric Cables" to "Electrostatic Units". Glass and glass manufacture occupy twenty pages; dyes, eight pages; hormones, four pages (we note, by the way, that the word endocrine is not indexed); glucosides, eight pages; furnaces, nine pages; gemstones, six pages; and geophysics, four pages. We have tested the volume for many words and terms used in various branches of science and technology, and have rarely been disappointed. Many biological terms are included but no attempt is made to cover this whole field, though "commodities of botanical and zoological origin are named and described". This accounts, perhaps, for the omission of 'gene' and 'genetics'.

No work of the same scope and standard has been issued in England for many years; and we congratulate the editors and publishers upon their production, which should find a place in every reference library.

Continuity of the Solid and the Liquid States

By Prof. J. Frenkel, Physico-Technical Institute, Leningrad

IT was believed until quite recently that liquids were in all respects—save their density—more similar to gases than to solid bodies. This belief was strengthened by the van der Waals' theory of the continuity between the liquid and the gaseous states, the sharp transition between them (corresponding to the boiling or condensation point) being replaced by the hook-like portion of the (p–v) curve, representing unstable intermediary states.

Recently, a number of new facts have corroborated the view that liquids—at least in the vicinity of the melting point—are much more similar to solids than to gases, not only with regard to density, but also with respect to the character of the *heat motion* and *structure*. As I pointed out ten years ago[1], the heat motion in simple liquids consists of vibrations about an equilibrium position which after an average time $\tau=\tau_0 e^{U/kT}$ (τ_0 is vibration period, T is temperature, U is activation energy) is shifted through a distance δ comparable with the interatomic distances. Under the influence of alternating forces with a period τ' much larger than τ, the liquid behaves in the ordinary way, displaying a viscosity coefficient $\eta=N\tau$, where N is a constant which can be defined as the rigidity modulus displayed by the same 'liquid' when subject to alternating forces with a period τ' much smaller than τ (amorphous solids are rightly denoted as supercooled liquids with a very large 'relaxation time' τ).

Still more recently, it has been pointed out (for the first time by Pauling) that the molecules in a crystalline solid can rotate more or less freely—just as has been assumed for liquids and gases; while Debye has shown[2] that both in liquids and solids there is actually no *free* rotation, but a sequence of rotational oscillations about an equilibrium orientation which is changed abruptly from time to time[3].

Finally, it has been shown—for the first time by Stewart—that the X-ray diagrams of liquids, especially in the vicinity of the melting point, are very similar to those of a microcrystalline solid. The process of melting, therefore, cannot be conceived as a sharp transition from the crystalline to the amorphous state: the liquid near the melting point is still to a great extent crystalline and becomes gradually more and more amorphous as the temperature is raised. On the other hand, a solid crystalline body, especially in the vicinity of the melting point, is no longer exactly crystalline, but contains a number of 'dissociated' atoms or ions which are irregularly distributed in the 'interstices' of the crystal lattice, and form the beginning, as it were, of the amorphous phase within the crystal. This 'dissociation' process explains diffusion in solids and the electrical conductivity of ionic crystals[4].

Thus we see that the usual conception of the existence of a fundamental difference between the solid and the liquid states is incorrect. I wish to put forward the contrary view, namely, that *the solid and liquid states are connected with each other in a continuous way, just as are the liquid and the gaseous states*. The fact of the existence of a sharp transition point between the solid and the liquid states does not in the least contradict this conception—just as the existence of a sharp boiling (or condensation) point does not contradict the continuity between the liquid and the gaseous states. It simply indicates that, just as in the latter case, a continuous transition from solid to liquid, corresponding to a gradual increase of volume and of the degree of amorphism, must go through a sequence of unstable states, characterised by the same hook-like shape of the pressure (p)–volume (v) curve, as that occurring in van der Waals' isotherms below the critical temperature. Hertzfeld and M. Göppert-Mayer[5] have indeed shown that the p–v curve for a number of crystals displays a minimum of pressure, which they interpreted as corresponding to the melting point. They were led to this interpretation—or rather misinterpretation—by the fact that solids cannot be superheated, in contradistinction from liquids. This law of analogy between the melting and the boiling process can, however, be very naturally explained by the fact that small liquid drops formed inside the solid cannot rise to the surface, as do the gas bubbles formed in a boiling liquid. Melting can therefore begin effectively at the surface only.

A more exact theory of the p–v isotherm for a crystal shows that the minimum of p discovered by Hertzfeld and Göppert-Mayer is followed by a *maximum*, so that we actually find a condition quite similar to that which is described by van der Waals' theory of the amorphous state. In order to build up an exact theory of fusion, it is necessary not only to consider the dependence of the vibration

frequency of the atoms (or molecules) on their mean distance apart more exactly than this has been done by the above authors, but also to take into account the *gradual amorphisation* of the body, which begins long before the melting point is reached. This 'amorphisation' can be regarded as the result of a large number of *local and temporary ruptures of the body*, due to the increase of the interatomic distances. To make this point clear, let us imagine that three atoms are put in a line and the distance apart between the two end atoms is gradually increased. Then the middle atom, which in a state of lowest energy should at the beginning lie just midway its neighbours, will finally move towards one of them, since the middle position, which initially corresponded to a minimum of the potential energy, will finally correspond to its maximum. The same result as that due to external forces, pulling the end atoms in opposite directions, must be produced by heat motion. To compare the two effects, however, we must consider not the *average* distances between the atoms as determined by the thermal expansion, but the maximum distances connected with thermal oscillations. It can thus easily be shown that a one-dimensional crystal with increase of temperature will not 'melt' but will break up into a number of small pieces (single atoms and doublets). In a two- or three-dimensional solid, a local 'rupture', however, will not lead to a breaking up of the whole body, thanks to the existence of lateral bonds between the atoms.

Although such local and temporary ruptures must take place also in a solid body, their number and importance greatly increase on melting, which accounts for the very much larger degree of 'amorphisation' which is found in the liquid state. This explains also the fact, first noticed by Rashevksy[6], that the latent heat of fusion is of the same order of magnitude as the elastic energy of the corresponding body strained to its theoretical breaking point at the zero point of temperature.

We thus see that the three states of aggregation of matter—the solid, liquid and gaseous—must be regarded as forming *one continuous sequence*, the sharp transition points—melting or boiling—being simply substitutes for continuous transitions through unstable intermediate states, corresponding to the hook-like parts of the p–v curve. At ordinary temperatures there are two such hook-like portions, the first one (for smaller v's) corresponding to the melting, and the second to the boiling point. Above a certain temperature T_1—the ordinary critical temperature of the substance—the second hook disappears, whereas the first one remains, since, as has been shown by Bridgman, and especially by Simon, it is possible to obtain under sufficiently high pressure a substance in the solid state above its critical temperature. A critical temperature $T_2 > T_1$ for which the first hook should also disappear does not exist (according to Bridgman the melting temperature displays a monotonic rise with increasing pressure). It is, however, very probable that there exists a critical temperature $T_0 \leqslant T_1$ (connected with a strongly *negative* value of the pressure) at and *below* which the first hook should disappear—corresponding to the fusion of the solid and liquid states into a single 'condensed' state.

A detailed mathematical treatment of the above questions will appear shortly elsewhere (in the *Jour. Phys.*, or the *Acta Phisicochimica USSR*).

[1] J. Frenkel, Über die Wärmebewegung in festen und flussigen Korpern, *Z. Phys*, p. 1, 1926.
[2] P. Debye, *Z. Phys.*, Feb. 1, 1935.
[3] A similar view has been expressed by the writer in a book on the "Theory of the Solid and Liquid States" (in Russian).
[4] cf. J. Frenkel, *loc. cit.*
[5] *Phys. Rev.*, Dec. 1934.
[6] *Z. Phys*, 1927.

Human Origin and Christian Doctrine

By Dr. W. D. Lang, F.R.S.

THE late Bishop Gore remarks, in his "Belief in God", that it is not so much about the existence of God that men dispute, as the nature of the God in whom they can believe. Sir Ambrose Fleming, in the second published edition of his presidential address to the Victoria Institute, on "Modern Anthropology *versus* Biblical Statements on Human Origin", takes a less tolerant view. In his belief, as he states it, that "adherence to the doctrine of [organic] evolution is entirely inconsistent with belief in the fundamental doctrines of Christianity . . .", he appears rather to embrace in one atheistical category all who do not subscribe to this belief; such, at least, is the irresistible impression one receives on reading his address. This premise, which at best can have but an individual, and not a general, application, will be further considered: but first, all who admit the transmutation of species—and they are a heterogeneous assemblage, and must include, besides

modernist churchmen, churchmen as orthodox as Bishop Gore, educated laymen, Christian and non-Christian, agnostics, atheists, and even early churchmen like St. Augustine—must settle down together and consider the rest of Sir Ambrose's discourse.

Two main themes, like the narratives in the early chapters of *Genesis*, run through the thesis, namely, the inadequacy of palæontology in general, and of anthropological palæontology in particular, to prove the transmutation of species; and the inadequacy of natural selection as a means of transmuting species. It is clear that, if the first point is admitted and the transmutation of species is thereby considered as disproved, it is meaningless to labour the second; yet both points are laboured, though somewhat intermingled, in a series of arguments, from which, perhaps, one on each point stands out more emphatically than the rest. If, says Sir Ambrose, in effect, transmutation of species has taken place, transitional forms would be commoner than they are; and he points especially to the few known remains of supposed man more primitive than *Homo sapiens*. It is probable that those who have had most experience of fossils, both in the field and in the study, would say that, considering the long succession of fauna after world-wide fauna presented to palæontologists, considering the comparatively few accessible exposures of rocks of any one age in the world, considering the small chances of any organism of any given age being preserved as a fossil, and, comparatively speaking, the very small amount of intensive and extensive collecting that has been done, it is wonderful how notably fossil species *are* found to intergrade; and they would probably agree that all the evidence points to there having been a transmutation of species. The chances against any organism, and especially a bony organism, being preserved as a fossil, also tells against Sir Ambrose's contention that the associated remains of *Pithecanthropus* and *Eoanthropus* do not belong, respectively, to one individual.

Again, Sir Ambrose argues that the apparent rate of increase in the population of the world is a datum for estimating the age of the human species; and he holds that thus it can be proved that the inconceivably long periods demanded by the Darwinians for the evolution of man are impossible. He does not accept the contention of Malthus and Darwin that populations are equilibrated by their environment, and that once the bands of a controlling environment are loosed, even the slowest-breeding species will increase by leaps and bounds—a supposition which is corroborated by observing the sudden and immense fluctuations in some recent animal populations, human races included, the causes of which, if not understood, are almost certainly environmental in the widest sense of that term. Were this not so, the whole world must have been filled with human inhabitants again and again, even in the comparatively short time allowed by Sir Ambrose Fleming since man's creation.

This ground has, however, been gone over many times; nor does it go to the root of Sir Ambrose Fleming's difficulties, as is clear from the following passage:

> "In rejecting the idea of Creation by Divine Will and Power, the evolutionist then claims that the only kind of beginning which can be accepted as true is one which appeals to his own finite intelligence. He is prepared to accept the Darwinian hypothesis because it is intelligible to him. . . . He rejects as untrue any statements about Nature which lie outside the limits of present human understanding and experience. . . . Thus, said an eminent naturalist, . . . 'the theory of evolution was a theory universally accepted, not because it could be proved to be true but because the only alternative, special creation, was clearly incredible' ".

Surely this passage goes to the heart of the matter, and reveals a misappreciation both on the part of Sir Ambrose and of his supposed opponents of the self-limitation of science. If it is true to say that a science is a marshalling of observed facts (a natural science, of observed physical facts) with the view of drawing logical inductions from them, it is clear that a natural science is self-limited, in its material (observed facts), in its method (logic), and in its standards (physical values). It must proceed from immediate effects to proximate causes, and so feels its way back to origins. It 'explains' the end by the beginning. It is otherwise with philosophy, which has its scientific aspect, and in this light might be called the science of significancies; but its material is all experience, and its standards are metaphysical values. It does not 'explain' the end by seeking its origin, but believes that the end 'explains' the beginning.

It is clear that, in the passage quoted above, Sir Ambrose Fleming is standing on metaphysical ground, and when he complains that his opponents reject "any statements about Nature which lie outside the limits of present human understanding . . ." he is really expecting them, as natural scientists, to go beyond the limits imposed by their system. They should answer that they must play the game, and seek proximate causes before they can feel back to ulterior causes, least of all adduce an ultimate cause. When, moreover, he points out that their arguments do not prove an anthropoid origin for man, they would answer

that such a biological theory, by its very nature, is incapable of mathematical proof, but must depend, like most such questions, on a balance of probabilities; and that is what Prof. Watson meant, in the passage quoted by Sir Ambrose, in saying that special creation was incredible. On the other hand, Sir Ambrose would be right in claiming that, as natural scientists, they are incompetent, through the very limitations of their method, to disprove the existence of God. In other words, Sir Ambrose and his opponents speak different languages, and on terms on which agreement is impossible.

We are thus brought back to Sir Ambrose's premise, that the acceptance of the doctrine of organic evolution is entirely inconsistent with the fundamental doctrines of Christianity. But, in complete sympathy with his ultimate conclusions, with genuine respect for his courage in upholding them, and in no self-complacent or dogmatic spirit, a Christian may yet ask what clause in the Christian creeds forbids him to be an evolutionist? Why may not a Christian believe, with the early Church, that the story in *Genesis* of man's creation is focused upon the spiritual truth that God created man, and is not to be regarded as a scientific account of the process? Why, if he honestly follows intellectual truth, may he not trust God not to lead him to intellectual confusion; and, although he cannot expect to solve all his intellectual difficulties, just because, as Sir Ambrose insists, his mind *is* finite, why may he not hope, like Job in similar circumstances, ultimately to gain a vision of God?

After all, what differentiates a Christian is what he thinks of the person of Christ, and this seems to bear but remotely upon the physical processes of creation. On this criterion, it must be admitted that the greatest evolutionist cannot be claimed as a Christian—"I gradually came," Darwin said, "to disbelieve in Christianity as a divine revelation"; on the other hand, he repudiated atheism. His life, however, largely belied the statement just quoted. For the Christian's God is also eminently expressed in all that is beautiful, good and true. Now, on his own showing, Darwin gradually lost his æsthetic faculty, as he gradually lost his Christian faith; but every page of his writings expresses that wide charity which is the hall-mark of goodness; while his life was a single-minded pursuit of truth. Surely, Sir Ambrose will allow that such a man, although an evolutionist and in spite of his disavowing Christianity, is yet not far from the Kingdom of God.

Poison Gas

THE menace to civilisation of attacks on cities from the air is naturally perturbing all the peoples of Europe, for it is generally agreed by those best able to judge that there is no effective means of defence, so that the attacked country would be obliged to retaliate on the cities of the aggressor. It is true that the use of gas in war was prohibited by the Geneva Gas Protocol of 1925, to which most of the principal powers of the world subscribed; but in view of the failure to effect general disarmament there is even less confidence in the protocol now than there was in 1925. The attack might be made by dropping bombs filled with high explosive, or incendiary composition or with gas, or gas might be sprayed. In the Great War gas was not used in this way, and consequently it is not possible to say from actual experience whether it would be more effective than high explosive.

Against troops who had been trained in the use of gas masks and other protective measures the statistics, so far as they go, indicate that gas shells cause about as many casualties as the same number of H.E. shells, but that they kill far fewer. The civilian population of a city could not be trained in protective measures to the same extent, and a large proportion would not have gas masks; but, on the other hand, they can take refuge in the houses, and so it should be possible to restrict the casualties. So far as can be judged in the absence of actual experience, these should be considerably less than those which would be caused by an equal weight of H.E. bombs. Probably the greatest damage, both physical and moral, would be done by squadrons of low-flying planes spraying gas followed immediately by others dropping H.E. bombs. If such an attack were delivered on a day when there were low clouds above which the approach could be made, and into which the attackers could dash again after the assault, it would not be possible for the defending fighting planes and anti-aircraft guns to accomplish much against them. If air raids should be made again in the future, they would, of course, be on a vastly greater scale than in the War. Consequently, it would be more possible to produce a lethal concentration of gas over such a large area as is needed for a decided military effect.

Hence the importance of educating the public in measures which would reduce the casualties to a fraction of the figure they might otherwise assume.

At the annual meeting of the British Science Guild held on June 12, a lecture[1] on gas defence was given by Mr. Davidson Pratt, general manager of the Association of British Chemical Manufacturers, and formerly an official in the Chemical Defence Research Department. Mr. Pratt dealt at fair length with the question of gas-protected rooms, of which he considers there should be one in every house or building, preferably situated on an upper floor. The preparations advocated would be decidedly troublesome and expensive, as they would involve not only closing all cracks and chinks with putty or mud, but also boarding up the windows outside and covering them inside with stout material such as wetted blankets or linoleum; also laying in a store of provisions, water and other necessities. It is evident that it would be difficult to do all this even in the houses of the well-to-do, and would be practically impossible in those of the poor. We should like to know whether these recommendations are based on actual experiments, and whether it would not be possible to make a room reasonably safe without rendering it useless for any other purpose than a refuge in emergency. If such experiments have not been carried out they should be put in hand, and the results published.

As regards gas masks, Mr. Pratt recommends that a type should be developed less expensive than the service one but sufficiently efficient for the needs of the general population. It is unsatisfactory that so little appears to have been done yet in this direction. The problem of clothing that will protect against mustard gas and lewisite is more difficult. Other subjects dealt with briefly in the lecture were the detection and diagnosis of gas and decontamination; but apparently, from what Mr. Pratt said, the methods and organisation required have not yet been worked out.

An anonymous pamphlet on this subject has also been issued by the Union of Democratic Control[2]. Considerable industry has been shown in collecting statements, but the comments of the writer are mostly misleading, so obviously misleading that they tend to produce in the reader a prejudice against pacifists rather than a hatred of war, which is the natural attitude of most Britons.

The chapter dealing with Mr. Davidson Pratt's lecture is headed "The Great Defence Hoax", and the general thesis is indicated by the statement on p. 60: "The authorities hope to succeed in rousing enough fear amongst people to persuade them to acquiesce in an armaments race, to make the danger of air attacks seem real and to encourage them to believe that the precautions against them will be effective". More agreement will be felt with the following sentence, which occurs almost at the end of the pamphlet: "The plain fact is that the only defence against air attack is the absolute prevention of war". Similarly the only real defence against burglary is the absolute abolition of burglars, but pending that our front doors are provided with latches.

ARTHUR MARSHALL.

[1] "Gas Defence." By J. Davidson Pratt, O.B.E. Pp. 14. (London: The British Science Guild, 6 John Street, Adelphi, London, W.C.2, 1935.) 1s.

[2] "Poison Gas." Pp. 63. (London: Union of Democratic Control, 34 Victoria Street, London, S.W.1, 1935.) 6d.

Obituary

Prof. J. B. Cohen, F.R.S.

IN the old organic chemistry laboratory at the University of Leeds there was a life-size bust of Liebig. It was perched high up on the top of some reagent shelves and it seemed as if the great 'master' of organic chemistry looked down and said, "All is well here". In many ways that bust was symbolic of the sway exercised in the laboratory by J. B. Cohen. He would have wished no better thing to be said of him than that he had tried to carry on the traditions made by Liebig for organic chemistry in the eighteen-fifties. Nicknames are often given to professors by their students as a sign of affection, but Cohen never received one from his. He was a little too austere for that. Instead he was usually called "Julius"—his first name. In a sense this was a greater sign of affection. It struck a deeper note of regard.

Cohen was born in Manchester in 1859 and lived almost the whole of his life in the north of England. Except for a couple of years in Munich in Baeyer's laboratory, he spent all his active scientific life in the Owens College and the Yorkshire College (later the University of Leeds). He went to Leeds in 1890. Previously, he was a demonstrator of chemistry at Owens College. His title at Leeds was lecturer in organic chemistry, and in 1904 he was appointed to a chair. Twenty years later he retired, having reached the age limit. He was made a fellow of the Royal Society in 1911. But when he retired he did not give up active work. During the next eight years he occupied a small suite of laboratories in the Leeds Medical School, and carried out a most laborious investigation on the antiseptic and trypanocidal activity of a large series of synthetic compounds, many of which he prepared himself. This was done

under the auspices of the Medical Research Council. When the last-named body decided to discontinue this line of work, Cohen really did retire, and he and his wife left Leeds and went to live at their country cottage near Coniston Lake. It was there amidst the beautiful surroundings which he loved that he passed away on June 14, after a few weeks' illness. He was then seventy-six years of age.

Cohen taught by example rather than precept. His research students will always retain ineffaceably in their minds a picture of his amazing industry, his high technical standards, his almost woman-like gentleness in dealing with their early errors, his reticent smile at anything which amused him and his abhorrence of anything which savoured of showmanship or attaining ends by any but transparently honest means. Those who came less closely into touch with him will remember his clarity as a lecturer, his great interest in the welfare of students and especially foreign students of the University, the Working Men's Club which he founded and personally conducted in one of the least attractive parts of Leeds, and not least his attempts by direct investigation to show the great evils wrought by the smoke-laden atmosphere of our industrial towns.

Cohen was an artist to his finger tips. A lover of music, he was no mean performer on the violin. He and his wife often gave delightful musical evenings to their friends both in the University and outside it. He painted well in water-colour and got great enjoyment in trying to put on paper in this medium his impressions of many parts of his beloved Lake District. With such a temperament his likes and dislikes were often very clear cut. They were sometimes an enigma to those who did not know him, but never to his friends. Few men are so honest and live their lives with such simplicity and dutiful routine as Julius Cohen did, and none can have tried more faithfully or wholeheartedly than he to serve his fellow men.

As a chemist Cohen did a considerable amount of valuable and fundamental work, but he did not make the kind of outstanding discoveries that open up new fields of activity. He was, however, very versatile, and from the titles of his published papers it may be seen that he covered a wide field. He was one of the old school of organic chemists who were mainly interested in the structure of carbon compounds and its influence on their properties and reactions—what may be called molecular architecture and its significance. The principal province of his work was that of aromatic substitution, especially of benzene compounds, and the laws which govern it. But he was also intensely interested in the problems of optical activity, and almost the last paper he ever wrote was on "Asymmetry and Life".

It was this mystery of the optical activity of naturally-occurring organic compounds, together with his great appreciation of the work of Pasteur, that probably directed Cohen's attention to the wide scope for chemical investigation provided by the activities of living organisms. This led him to advise many of his research students—the first being H. D. Dakin—to take up the study of what was then called physiological chemistry and is now named biochemistry. None who were so advised can have regretted their choice, and the enormous development of biochemistry during this present century proves how right Cohen was in his appreciation of the contributions that the chemist could make in the biological field.

Organic chemists owe a great debt to Cohen because of his books. The smallest of these was probably the most important—his little "Practical Organic Chemistry". There was no book anything like as satisfactory when it was first published, and it has guided innumerable students in their first steps in the subject. Indeed it is still widely used. His greatest production was the three-volume "Advanced Organic Chemistry", and it is a tribute to his industry and wide reading that he could write such a book and yet carry out his normal day's work at his bench in the laboratory. Organic chemistry is now almost getting beyond the compass of a one-man book, but this "big Cohen" is still one of the books which are highly valued by advanced students in Great Britain. To many, Cohen's books will be his most lasting memorial, but those who had the privilege of his friendship will always in addition be grateful for the virtue they derived from the man himself.

H. S. R.

Prof. Max Cremer

On May 22, a few weeks only after celebrating his seventieth birthday, Max Cremer, emeritus professor of physiology in the University of Berlin and formerly head of the Physiological Institute of the Veterinary College, Berlin, died in Munich. He was one of the last representatives of the classical German school of physiologists who mastered both biochemistry and biophysics.

Cremer started his scientific career as a pupil of Carl Voit and Soxhlet by investigating animal metabolism, particularly the formation and utilisation of carbohydrate in the body. He succeeded in proving that the organism is able to synthesise glucose and glycogen from certain breakdown products of organic matter, for example from glycerine. Although he maintained a fruitful interest in these problems, he soon turned his main activities to electrobiology, a field very congenial to his talents in mathematics and physics. In 1906, he discovered the existence of considerable potential differences between suitable watery electrolytes separated by a phase immiscible with water (glass, nitrobenzene). This fact formed the basis of the present view of electrical phenomena in living matter, and on the practical side, of the use of the glass electrode for hydrogen ion measurements.

Regarding the electric change in nerve as the essential factor concerned in the origin and propagation of the impulse, Cremer combined physico-chemical and physiological terms in an ingenious manner which culminated in a formula for the velocity of the impulse and in a mathematical expression for the processes preceding excitation. He also promoted the technique of recording the rapid

potential changes occurring in tissues (the invention of a string electrometer; the first physiological application of the cathode ray tube and the loop oscillograph in 1907 and 1912).

Although Cremer was extremely critical and even sarcastic in the scientific sphere, he was humorous and cheerful in ordinary life. This mixture in his imposing personality was very manifest in speech and discussion, and will not be forgotten by his pupils and friends. H. ROSENBERG.

WE regret to announce the following deaths:

Mr. C. T. Kingzett, one of the founders of the Institute of Chemistry, and author of the "Chemical Encyclopædia", and other books on chemistry, on July 29, aged eighty-two years.

Prof. W. R. Sorley, Knightsbridge professor of moral philosophy in the University of Cambridge, author of many well-known works on ethics, on July 28, aged seventy-nine years.

Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association, president of the Manchester Literary and Philosophical Society in 1929–31, on July 23, aged seventy-nine years.

Prof. F. A. F. C. Went, For.Mem.R.S., extraordinary professor of botany in the University of Leyden, and emeritus professor of botany in the University of Utrecht, on July 24, aged seventy-one years.

News and Views

Dr. Griffith Evans

WE extend our congratulations to Dr. Griffith Evans, who will attain his hundredth birthday on August 7. Dr. Evans was a pioneer in the study of protozoology in connexion with infections, and the first man to associate trypanosomes with the production of disease. He was born at Tymawr, near Towyn, Merionethshire. After studying medicine for a short time with a medical practitioner at Towyn and Aberdovey, he entered the Royal Veterinary College, London, where he qualified as M.R.C.V.S. In 1877, he was sent to India in the Army Service Corps. It was there that his great work on blood parasites was carried out. On arrival in India, he was appointed to investigate an endemic disease which for many years had been fatal to cavalry and artillery horses; by microscopic examination of the blood, which revealed the specific bacillus in the blood of every patient, Evans at once proved the disease to be anthrax fever.

IN 1880, Dr. Griffith Evans's work on surra began; and upon studying the reports which had already been made upon the disease he at once reached the opinion that it was due to some parasite of the blood. His first act was to examine microscopically the blood of a surra patient: it was swarming with parasites. Though Koch had not yet made his classical postulates, and though Evans was ignorant of the nature of the microbes revealed to him, he immediately associated them with the production of the disease. They were the parasites which, at first called *Trichomonas evansi*, are now known as *Trypanosoma evansi*. Official opinion was strongly against him, but the Government printed his reports, and he had the gratification of knowing that his statements spurred on a number of younger men to continue investigations along lines which he had laid down. He returned to England in 1885, and after further work in Crookshank's laboratory, King's College, London, retired from the army in 1890. In 1917 he was awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine, in recognition of his distinguished scientific work, and on that occasion he wrote a short autobiographical memoir, which was published in vol. 12 of the *Annals of Tropical Medicine and Parasitology*.

Alcohol and Road Accidents

EARLY this year, the Minister of Transport asked the British Medical Association whether it could usefully make any observations on the place of alcohol in the causes of road accidents, in the light of existing knowledge and experience. The Association thereupon appointed a special committee to consider the subject and the report of this committee has just been published (*Brit. Med. J.*, Suppl. July 27, 1935; p. 57). The committee confined itself to an examination of the scientific evidence on the effect of the consumption of alcohol on the functioning of the body, especially of amounts insufficient to produce the state commonly recognised as drunkenness. The Alcohol Committee of the Medical Research Council concluded that the direct effect of alcohol upon the nervous system is, in all stages and upon all parts of the system, to depress or suspend its functions; it is, in short, simply a narcotic drug. The earliest effects are an impairment of the faculties of judgment, concentration, self-criticism and the power of estimating risk, which are often accompanied by a sense of well-being and of self-satisfaction. At the same time, the power of making movements dependent on rapid and accurate co-ordination is adversely affected; the rapidity and accuracy of neuro-muscular co-ordination are diminished. The report reviews the experimental evidence on which the above statements are based, and points out that as little as three ounces of whisky produces these effects. The experiments were of course made in other connexions to determine the effects of alcohol upon the nervous and neuro-muscular systems; but

are applicable to motorists, whose movements are dependent on rapid and accurate co-ordination between the eyes, hands and feet. The committee also emphasises that the elimination of alcohol from the body is a slow process: 10–12 c.c., or the equivalent of one ounce of whisky, can be oxidised each hour, and the rate is not increased when the concentration in the blood is raised by drinking larger quantities. The committee concludes that the driving capacity of a driver, who has taken even small amounts of alcohol, must frequently be adversely affected, even when it has been consumed some hours before driving, and especially if taken in the absence of food.

Production of Oil in Great Britain

ONE of the most striking characteristics of the times is the tendency of man to make himself less dependent on the circumstances imposed by geographical conditions. Formerly it was necessary to settle, and for industries to develop, where sources of food and raw materials were readily accessible. Now the tendency is for these things to be done just where man chooses—but at a certain price. Modern civilisation demands oil and oil products, and our need is being in part met by the treatment of coal. In the House of Commons on July 24, the Secretary for Mines (Captain Crookshank) reported that the plant at Billingham for coal-hydrogenation is now working and will, when at full output, produce 45,000,000 gallons of motor spirit yearly—3¾ per cent of our annual consumption. By August, the total production—including that from distillation of oil shale and coal—will reach 60,000,000 gallons, increasing to 90,000,000 gallons when the Billingham plant attains full output. Although petroleum can be got from the earth for relatively slight efforts, one of the chief merits claimed for coal-hydrogenation is the magnitude of the labour it requires and the employment it gives. This, however, is small in comparison with the size of the coal industry. The present Billingham output employs 1,900 miners and 1,000 plant employees, and it does not seem probable that the process can restore the former prosperity of the mining industry. Capt. Crookshank also stated that 43 applications had been received to prospect and work for oil in Great Britain.

Mr. Lloyd George's Scheme of National Reconstruction

MR. LLOYD GEORGE'S scheme of national reconstruction is outlined in a pamphlet entitled "Organizing Prosperity" (Ivor Nicholson and Watson. 6*d*.). His main thesis is that our economic system can be amended without being scrapped, and that the immense advantages of individual enterprise, energy and initiative which our present economic system fosters are not to be lightly sacrificed. They must rather be controlled and cultivated so that they may yield an ordered harvest for the nation. He gives first place to the land as a means of finding not only temporary employment during a period of exceptional trade depression, but also permanent employment for our surplus population. Other projects advocated include housing and slum clearance, electrification of suburban railways, improvement of ports and docks, extension and improvement of electrical supply, road developments, water supply, telephone extensions and financial assistance for development of oversea markets. These various schemes would be financed by a 'prosperity loan', while the carrying out of the programme would be entrusted to a National Development Board consisting of a small body of persons of distinguished competence drawn from industry, commerce, finance, workers and consumers who would be appointed for a definite term and would be responsible to the Cabinet. But since a Cabinet of about a score of Departmental Ministers is an unsuitable body to give full and dispassionate consideration to bold schemes of national reconstruction, Mr. Lloyd George advocates a reversion to the War-time arrangement of an executive consisting of the Prime Minister and four or five Ministers without departmental duties.

Science and Vocational Advice

IN a Friday evening discourse delivered at the Royal Institution on May 10, and now available as a pamphlet, Dr. C. S. Myers discussed the "Scientific Approach to Vocational Guidance". He compared the giving of vocational advice with the giving of medical advice. Each is an art, yet each depends on the use of scientific knowledge and methods. The individual must be studied with regard to every relevant aspect of himself and his environment. In vocational guidance, the part played by psychological tests is essential, although relatively small. It is now possible to estimate intelligence fairly accurately, by means of 'verbal' and 'practical' tests, and as the degree of intelligence required varies in different groups of occupations, this is one very important deciding factor. But tests for character and temperamental qualities are not yet sufficiently reliable; and the chief contribution of the psychologist in this direction has been in the introduction of improved and systematic methods of assessment. Other qualities necessary for success in certain occupations are mechanical ability and manual ability. Tests for these abilities and others, based on a detailed study of some one occupation, can be applied in vocational *selection* where the problem is one of selecting the best person for a particular job. The co-operation of parents, teachers, school authorities and juvenile employment officers provides a necessary contribution to the data on which the vocational adviser's advice is based. The follow up of advised cases, and comparison with the results obtained from a control-group are now recognised parts of the experimental procedure. During the past nine years, the number of cases dealt with in Great Britain by the two bodies responsible for most of such research was 6,751; in 1925 the number of vocational guidance cases was less than 100.

T. A. Coward Memorial Sanctuaries

ON July 22, the Earl of Crawford and Balcarres opened the Nature sanctuary at Cotterill Clough.

Cheshire, formed by public subscription in memory of the late T. A. Coward, sometime lecturer in the University of Manchester and author of "The Birds of Cheshire", "The Fauna of Cheshire", etc. The deeds were handed over to the Society for the Promotion of Nature Reserves. The Earl of Stamford, chairman of the memorial committee, said 1,570 people from all parts of the world had subscribed £925 to save this well-known haunt of fauna and flora, and also a second memorial sanctuary at Marbury Mere, and subscriptions coming from so far apart as Canada and Hong-Kong showed the wide appreciation of Mr. Coward's work. The sanctuaries were chosen not only for their own particular appropriateness and value for study, but also because Coward himself studied in them so often. One part of the sanctuary will be permanently closed as a true Nature sanctuary for wild life, but a public right of way will exist at another part where visitors can see down the sanctuary and hear the bird songs. A bronze memorial plaque on a glacial boulder brought from the Bollin Valley is inscribed: "In Memory of Thomas Alfred Coward, M.Sc.,—1867–1933—Cotterill Clough and Marbury Reed Bed were purchased by public subscription to remain for ever undisturbed Nature reserves as a memorial to his great services to natural science". Already studies have been made in the sanctuary by the Manchester branch of the British Empire Naturalists' Association and the Altrincham Natural History Society. The opening ceremony in the Clough was attended by delegates from natural history, scientific, ramblers, and other bodies chiefly from the north of England.

Recent Archæological Discoveries in Crete

OPPORTUNITY for further study of the archæological material found in a cave at Arkalokhori in Crete (see NATURE, July 6, p. 15) has led to some modification of opinion as to its character, though not as to its importance. Sir Arthur Evans, in a communication to *The Times* of July 29, states that as a result of comparative study of the hieroglyphic inscription in three vertical lines on the votive bronze double axe, he has arrived at the conclusion that it does not, as at first supposed, represent an exotic script. He finds that while one or two new forms appear, nearly all the signs have close parallels in the Cretan series, while two recur in the same collocation on a faceted hieroglyphic cylinder in his possession. He is, therefore, of the opinion that the language is identical, though the new inscription, from its associations with material belonging to Late Middle Minoan, must be regarded as late in its class, dating from about 1600 B.C. From one of the lairs of a badger, from which animal the locality takes its name, a fairly complete series of potsherds, covering most of the Minoan periods, was recovered. Sir Arthur, passing on in the same communication to recent work at Knossos, chronicles an exploration of Minoan deposits, in which the most remarkable discovery was a small limestone head. This was of a markedly dolichocephalic early Egyptian type, though associated with relics of the closing Middle Minoan age. Mosaics of Hadrianic age from a villa recently found in the vineyard of the Villa Ariadne, in which the heads of Dionysiac figures in medallions are the recurring subject, have been pronounced to excel any Roman specimens of the kind yet found in Greece.

Origins of Man in America

SEARCH for evidence bearing on the problem of early man in America, which has been carried on in New Mexico during the past five years by Mr. Edgar B. Howard under the auspices of the Academy of Natural Sciences and the University Museum, Philadelphia, is now to be extended farther afield. When it was announced a few years ago that the stone implements of a type hitherto unknown in America, but now known as 'Folsom points', had been discovered near Folsom, New Mexico, by Prof. E. B. Renaud, of the University of Denver, a new orientation was given to the study of American archæology, more especially in the attitude towards alleged associations of artefacts with the bones of extinct or presumedly early fauna. An antiquity for man in America greater than that generally admitted seemed a possibility. Mr. Howard's explorations in New Mexico, of which an account is to appear in the *Museum Journal* (Philadelphia), and especially his discoveries in a cave west of Carlsbad and in old lake beds near Clovis, New Mexico, at a depth of eight feet, of artefacts and traces of camp fires in association with the remains of extinct fauna—camels, wild horse, elephants—indicate that Folsom man had penetrated to the south-west in Pleistocene times, when the Wisconsin ice-sheet was waning, a period of climatic change tentatively fixed at 10,000 years ago. No contemporary human remains have been found. Mr. Howard is of the opinion that further evidence must be sought in Asia, and is now on his way, with the assistance of the Philadelphia Academy of Natural Sciences, to Russia, where he proposes to study the archæology of Siberia and hopes to enlist the co-operation of the Soviet authorities in further exploration. In the meantime, Dr. F. de Laguna, also on behalf of the Philadelphia Academy of Natural Sciences, has resumed her researches in Alaska—on this occasion in the Yukon Valley and with the object of tracking Folsom man on his way to the south-west.

Marriage Hygiene

A NEW quarterly journal, *Marriage Hygiene*, with a strong editorial board consisting, for the time being, of a number of prominent Indian medical men, has recently appeared from the *Times of India* Press, Bombay. Its objects are to secure for the science of conjugal hygiene a proper place in preventive medicine, to publish contributions which are believed to be necessary for scientific, sane sex teaching, and to bind its readers together into a brotherhood of clean thinkers and bold fighters against prejudice and taboos; and it is intended, by additions to the editorial board, that the journal should become an international one. The first number consists of

articles published elsewhere by Havelock Ellis, Julian Huxley, Norman Himes and others, and includes several pages of abstracts and reviews of books. In the second number there is an excellent article by Norman Himes on contraceptive technique in Islam and Europe in the Middle Ages. The articles so far published indicate the scope of the journal and the quality of its contributors. It promises well, and should receive a welcome from all who are interested in those problems which arise from the relation of male to female and of parent to offspring. The price of a volume is 18*s*., and the address of the managing editor is Kodak House, Hornby Road, Bombay. Surely it is a matter of profound significance that such a journal should have had its origin in India, particularly when it is learned that, associated with the journal, there is a eugenic clinic. It would seem that this journal intends to deal frankly and scientifically with a number of topics that are not usually encountered in the ordinary medical journals.

Recent Acquisitions at the British Museum (Natural History)

THE Zoological Department has received, as a donation from His Excellency the Governor of Sierra Leone, the skull and tusks of a young specimen of the forest elephant, from the Gola Forest, Sierra Leone. This specimen is of exceptional importance as it is accompanied by two complete tusks which are in every way similar to the tusks hitherto accepted as belonging to the so-called 'dwarf' elephant. The skull and teeth of this specimen prove it to be quite a young individual and therefore it is reasonable to conclude that the so-called 'dwarf' elephant ivory is merely the ivory of young elephants. 135 mammals, 144 birds, 9 reptiles, and 500 fishes from Ashanti have been collected for the Museum by Mr. Willoughby P. Lowe and Miss Waldron, and about 200 birds collected in southern Asia Minor by Mr. Charles Bird have been purchased. The important collection of British Lepidoptera formed by the late Robert Adkin, who died at Eastbourne on May 21, has been bequeathed to the Department of Entomology. This collection consists, at an estimate, of about 50,000 specimens, and embraces the microlepidoptera as well as the larger kinds to which most collections are confined. The Trustees approved the purchase for the Department of Geology of an important collection of some two thousand Australian fossils, including fishes, representatives of most of the invertebrate groups, and plants. It is particularly valuable on account of the large number of Permian and Triassic insects, including more than 100 types, which it contains. An interesting and valuable gold nugget from Morro Velho, Minas Geraes, Brazil has been bequeathed to the Department of Mineralogy, by the late Mrs. M. A. Bushnan, of Kew. The nugget, which weighs 119·3 grams, or nearly 4 ounces troy, consists entirely of native gold, all the original quartz having been removed, leaving a cellular structure. Among the purchases may be mentioned: a splendid scissor-cut yellow scapolite, weighing 12·3 carats. The rough stone was from Serra da Chibita, Minas Geraes, Brazil. Scapolite of gem quality is not common, and this specimen is larger and of better colour than any other in the National Collection.

A Disease-Resistant Red Currant

A SHORT note issued by Science Service of Washington, D.C., announces the discovery by Dr. G. G. Hahn of a new variety of red currant resistant to the uredo- and teleuto-spore stages of *Cronartium ribicola*, the white pine blister rust fungus. This organism is heterœcious, spending its life-history on two distinct host plants. Currants and gooseberries are the summer hosts, whilst the æcidial stage is spent upon white pine (*Pinus strobus*) in the winter. Many districts in America regard the white pine as their principal source of wealth, and so both wild and cultivated currants and gooseberries were eradicated completely. This caused much grief and expense to gardeners, but removed the necessary summer hosts of the fungus, and effectively controlled the disease on white pine. The new disease-resistant red currant is known as 'Viking'; it provides fruit of good quality, and promises to withstand drought as well as to resist disease.

Centralisation of Scientific Publication

IN an address on "The Dissemination of Science" before the American Association for the Advancement of Science at Minneapolis on June 26, Mr. Watson Davis, director of Science Service, reiterated a plea for the co-operative centralisation of some scientific publication functions in a Scientific Information Institute. It was suggested that manuscripts which could not be published promptly or in full should be sent to the Institute and prepared by typing or otherwise for photographic publication. The existence of the paper or monograph would be made known through the publication of the abstract in the scientific journal, and the paper could be obtained on request, each copy being made to order. The same system could be utilised for supplying to members the scientific papers delivered at a meeting. The photographic procedure might also be utilised for loans between libraries. In regard to bibliography, Mr. Davis suggested the operation by the Scientific Information Institute of a bibliographical file and production service to absorb existing bibliographical schemes in all branches of science and provide bibliographical material in fields of science which are at present not easily accessible. A fund of approximately 20,000 dollars would enable these projects to be initiated.

The National Central Library

THE nineteenth annual report of the National Central Library, Malet Place, London, W.C.1, directs attention to the difficult financial problems which at present confront the Committee. These are due partly to the inadequacy of its income to meet the growing demands made upon the Library and partly to the termination of the annual grants received from the Carnegie Trustees, from whom a final grant of £4,000 has now been received. The annual grant

of £3,000 from the Treasury has again been reduced by 10 per cent, and it has only been possible to spend £2,337 on books, the smallest expenditure for seven years. The financial difficulties are the more unfortunate when the work of the Library in tracing out-of-the-way books and acting as a clearing-house for the entire library system of Great Britain and a chief source of all bibliographical information is becoming more widely known and appreciated. The report contains references to the 'outlier libraries'—which now number 149, including those of a number of research associations, the regional library systems, the university libraries, and the foreign libraries—which will probably surprise the average scientific worker in the extent to which they reveal the co-ordination of effort in this field. Moreover, as the regional system grows, the work represented by each book issued by the Central Library continues to increase, as although the number of books issued may decrease the percentage of books difficult to trace and obtain becomes higher. Of particular interest is work on Union Catalogues, and the Union List of Periodicals in the University Libraries has been of the greatest service in locating periodicals. The report also refers to a Union List of Scientific, Technical and Commercial Periodicals in the Public, the University and all the Technical Libraries in Sheffield. A total of 61,187 books was issued by the National Central Libraries and 11,231 by the outlier libraries, which contain 5,846,000 volumes; 2,409 books were lent to university libraries, 1,233 of which were supplied from the Library's own stock.

Thermo-couple Standardisation

THE use of thermocouples for the measurement of temperature has become so customary in industry that the issue by the Bureau of Standards of the United States of a pamphlet of 36 pages by Messrs. W. F. Roeser and H. T. Wensel on the methods of testing them and the materials of which they are constructed will be welcomed by many workers in industry. It is Research Paper 768 of the Bureau, and is issued at the low price of 5 cents. It deals with the best materials to use for a given range of temperature, how to secure that they are pure and how to standardise the couples when constructed. On the whole, the authors prefer a freezing point rather than a boiling point for a standard temperature when each is available, but instructions are given for carrying out standardisations in each way and also for comparisons with working standards of the thermo-couple type. The best methods of interpolating for temperatures between the standard temperatures are also dealt with. Some idea of the accuracy to be expected from observations with various types of thermo-couples over different ranges of temperature is also given.

The World Power Conference

AT the annual meeting of the International Executive Council of the World Power Conference, held at the Royal Netherlands Institute of Engineers, The Hague, Sir Harold Hartley, chairman of the British National Committee, was elected by the Council as its chairman, in succession to the late Mr. D. N. Dunlop, who died on May 30. The choice of Sir Harold is peculiarly appropriate, since as a vice-president of the London Midland and Scottish Railway Company, and director of research of that great transport system, he is in close touch with industrial problems, while as chairman of the Fuel Research Board and a research fellow of Balliol College, Oxford, he is also conversant with the more academic aspects of scientific progress. The Conference owes to Mr. Dunlop, its founder, a happy combination of the practical with the ideal. Under Sir Harold Hartley's guidance it should continue to progress and to play an increasingly influential rôle throughout the world.

Dovedale

MR. ROBERT MCDOUGALL, of Manchester, has presented to the National Trust further sections of Dovedale. The dale lies partly in Derbyshire and partly in Staffordshire, and it was recently announced in Parliament that steps were being taken by the local authorities concerned for the planning of the whole area. This announcement was warmly welcomed by the National Trust. Now Mr. McDougall has added to his previous gifts 52 acres in Biggin Dale which joins Wolfscote Dale—as the upper part of the Dove valley is called—on the Derbyshire side some way above the land recently given by Imperial Chemical Industries, Ltd. Biggin Dale is a dry limestone gorge of great beauty. The new property, on its north-western side, consists of steep grass slopes with picturesque screes and some timber and hawthorn bushes, and from it there are arresting views down the Dove valley. There are also fine views across to the Staffordshire side of the Dove valley where the Peasland Rocks stand out boldly. Above the property is Wolfscote Hill (1,272 ft.) which, with its long ridge, is a great landmark in the neighbourhood.

Italian Council of Research

THE recent activities of the Italian National Council of Research, which is directed by the Marchese Marconi, are described in an official publication dealing with investigations which the Council has handed over to the universities, higher teaching centres and experimental stations in Italy. During the years 1933 and 1934, researches were carried out in the problems of nutrition in the laboratories and institutes of physiology and biochemistry at Naples, Padua, Genoa and Rome, as well as investigations on the etiology, epidemiology and prophylaxis of typhoid fever in the institutes of hygiene at Bologna and Genoa.

Toxicity of Industrial Solvents

AT the request of the Home Office, the Medical Research Council has undertaken to promote investigation into the question whether various volatile substances might injure the health of workers using them under industrial conditions. The Council has appointed the following special committee to assist and advise in this matter: Sir Joseph Barcroft

(chairman), Mr. J. C. Bridge, Prof. A. J. Clark, Prof. A. G. Green, Prof. J. A. Gunn, Prof. E. H. Kettle, Dr. H. B. Morgan, Mr. J. Davidson Pratt, Mr. D. R. Wilson and Sir David Munro (secretary).

International Office for the Protection of Nature

THE Dutch and French Governments have now officially recognised the International Office for the Protection of Nature at Brussels and have appointed the following delegates to be their representatives on the general council of the Office: *Netherlands and Dutch East Indies:* Dr. P. G. van Tienhoven, president of the Society for Nature Protection in Netherlands; Dr. W. A. J. M. van Waterschoot van der Gracht, chief engineer of mines; Prof. L. Ph. le Cosquino de Bussy, director of the Colonial Institute, Amsterdam; Dr. J. C. Koningsberger, former Minister of Colonies. *France and Colonies:* M. M. Bolle, conservator of forests, Ministry of Agriculture, Paris; Prof. A. Gruvel, general secretary of the National Committee for the Preservation of Fauna and Flora in the Colonies; M. Raoul de Clermont, president of the Section for Nature Protection of the Société Nationale d'Acclimatation de France.

Speleological Research in Great Britain

AT the meeting of representatives of associations interested in the exploration of caves from Yorkshire and Lancashire, Derbyshire and Staffordshire, Somerset and Devon, South Wales and Ireland (see NATURE, July 20, p. 98) held at Derby on July 27, over which Prof. L. S. Palmer (Hull) presided, it was resolved to form a British Speleological Association to serve as a clearing house for the co-ordination of the hydrological, geological, geographical, archæological and biological aspects of cave exploration, and for the dissemination of information relating thereto. In the course of the discussion which preceded the carrying of the resolution, stress was laid on the damage done by promiscuous and uninstructed digging in caves, Mr. A. L. Armstrong (Warrington) in particular urging the need for training before any attempt is made to carry on the work of excavation. The meeting also adopted a proposal that Sir Arthur Keith should be invited to become the first president of the Association.

Awards of the Royal College of Physicians

AT a meeting of the Royal College of Physicians of London held on July 25, the president announced the award of the Baly medal to Dr. F. H. A. Marshall, as a pioneer in the experimental investigation of sexual physiology and the relation of hormones to it; and the award of the Bisset Hawkins medal to Sir George Newman, for his distinguished services to public health, and more particularly for the leading part played by him in the institution of social medical services. Leverhulme scholarships were awarded to Dr. R. L. Noble and Dr. C. C. Ungley; and a grant from the same fund to Dr. Janet Vaughan to continue the work on which she was engaged before relinquishing her scholarship. Dr. E. G. L. Bywaters and Dr. L. C. Bousfield were re-appointed for six months as Mackenzie Mackinnon scholars. The Murchison scholarship was awarded (by the University of Edinburgh) to W. M. Wilson.

Announcements

THE twelfth International Congress of Zoology will be held at Lisbon in September under the presidency of Prof. Arthur Ricardo Jorge, Jr. Further information can be obtained from the general secretary, Congrès international de Zoologie, Faculté des Sciences, Lisbon.

A CONFERENCE on academic freedom will be held in the University Museum, Oxford, on August 14–15. It will be divided into three sessions, namely: academic and professional freedom; international professional relief; and the utilisation of science. Among the speakers will be Bertrand Russell, G. D. H. Cole, Prof. N. Bentwich, Miss J. Thomas, Prof. H. Levy, L. J. Hodgson. Further information can be obtained from C. R. Morris, Balliol College, Oxford.

THE tenth and eleventh reports of the Committee on Contact Catalysis, Division of Chemistry and Chemical Technology, have been issued together by the National Research Council, Washington. They deal with general aspects of catalysis, activated adsorption, the nature of chemical binding, interchange of energy in molecular collisions, chain reactions and some technical applications of catalysts.

APPLICATIONS are invited for the following appointments, on on before the dates mentioned:

A temporary assistant lecturer in applied mathematics in the University of Liverpool—Registrar (Aug. 10).

A biochemist (part-time) for the Pathological Department, Manchester Northern Hospital—The Secretary, J. C. Daniels, 38 Barton Arcade, Manchester (Aug. 10).

A lecturer in botany in the United College, St. Andrews—Secretary and Registrar (Aug. 10).

An assistant (Grade III) and a temporary assistant (Grade II) in the Admiralty Compass Department, Slough—Secretary of the Admiralty (C.E. Branch), London, S.W.1 (Aug. 10).

A veterinary research officer to the Government of Burma—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 14).

An assistant lecturer and demonstrator in engineering in University College, Cardiff—The Registrar (Aug. 19).

Two assistant keepers at the Victoria and Albert Museum—Director and Secretary, South Kensington, London, S.W.7, marked "Assistant Keeper" (Aug. 31).

City microbiologist to the Municipal Council, Colombo, Ceylon (candidates to be from the United Kingdom)—Messrs. John Pook and Co., 68 Fenchurch Street, London, E.C.3 (Sept. 30).

A lecturer in geography and mathematics in St. Hild's College, Durham—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 187.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Fundamental Paradox of the Quantum Theory

UNDER the above title, Prof. G. Temple[1] deduces the paradox from the general principles of the quantum theory, that any two operators representing physical variables must commute. If this conclusion be correct, it would involve fatal consequences; therefore we should like to point out that the commutability of operators does not follow from the general principles, but only from the particular and rather arbitrary principle of symmetrisation, which Prof. Temple claims to have deduced, but which is a new hypothesis in reality.

It is generally accepted that "physical variables $a, b, c, \ldots$ are represented by symmetric linear operators $A, B, C, \ldots$ in Hilbertian space; and the representation satisfies the following conditions:

$$a^2 \to A^2,\ \lambda a \to \lambda A \text{ (}\lambda\text{ being an ordinary number)}$$
$$a + b \to A + B."$$

Furthermore, it is also admissible to conclude from the relation $ab = \frac{1}{2}(a + b)^2 - \frac{1}{2}(a - b)^2$, which is also a c-number relation, that $ab \to \frac{1}{2}(AB + BA)$. This way of symmetrisation is unique, if products of only two physical variables are considered. In the case, however, of using products of more than two physical variables, this symmetrisation can no longer be derived uniquely from a c-relation. For then it is possible to convert artificially the case of two variables into the case of three variables, having then several possibilities of symmetrisation.

We put, for example, $A = (FF^{-1}).A$, where F is an operator and F^{-1} its reciprocal. Assigning $F^{-1}A = D$, then evidently $ab = fdb$.

According to Temple's symmetrisation

$$fd.b \to \tfrac{1}{4}(FD + DF)B + \tfrac{1}{4}B(FD + DF).$$

Here, and in the general case of three variables, we will choose, however, in a more symmetrical way the sum of all six permutations of the three variables.

All the different possibilities of symmetrisation give the same result only then, if the variables commute. Hence we cannot conclude that all variables must commute because a special prescription of symmetrisation does not exist in quantum mechanics.

Note added in proof.—Further consideration shows that, starting from the above representation of physical variables by linear operators as assumed by Prof. Temple, the correct symmetrisation of products of physical variables should be made by forming the sum of all the permutations of the variables.

A detailed report on the question of symmetrisation will be published later.

H. FRÖHLICH.
E. GUTH.

Institut für theoretische Physik,
Universität,
Wien.
June 15.

[1] G. Temple, NATURE, 135, 957, June 8, 1935.

To remove any possible misunderstanding, let me say explicitly that the argument of my previous letter was not intended as a serious demonstration that any two operators representing physical variables must commute, but as a definite proof of the existence of some serious and fundamental defect in the form of modern quantum theory. The criticisms to which the argument has been subjected have concerned either the conditions which were assumed to be satisfied by the representation of variables by operators, or the method by which the representation of a triple product was obtained.

With regard to the first group of criticisms, it is sufficient to reply that the assumed conditions are universally accepted, and that the denial of any one of them is as fatally destructive of the present form of the quantum theory as is the acceptance of the commutability of any pair of physical operators. To say that the same variable need not always be represented by the same operator renders it impossible to interpret any operational formula: to deny that $a + b \to A + B$, unless A and B commute, makes it impossible to construct any Hamiltonian operator as the sum of the operators representing the kinetic and potential energies: to deny that $a^2 \to A^2$ invalidates the whole theory of the momentum operators.

Criticisms of the second kind have usually taken the form of the assertion that the operator representing abc is

$$\tfrac{1}{24}\{(A + B + C)^3 - (-A + B + C)^3 - (A - B + C)^3 - (A + B - C)^3\},$$
$$\equiv \tfrac{1}{6}(ABC + BCA + CAB + CBA + ACB + BAC).$$

Certainly, this is *a* legitimate deduction from the premises, but it is not the *only* possible deduction. I agree with Messrs. Fröhlich and Guth that in the case of triple products a unique form of the representation cannot be derived from c-relations between variables. But I deny that I have employed a "particular and rather arbitrary principle of symmetrisation . . . which is a new hypothesis in reality". I have based my deduction on the three premises admitted by Messrs. Fröhlich and Guth, and I challenge them to point out at what stage in my argument any further assumption has been made. Any triple product abc is also a double product of a and bc, or of b and ca, or of c and ab, and its representations are therefore deducible by the recognised rule for all double products, that is, that

$$xy \to \tfrac{1}{2}(XY + YX).$$

This is the gist of my argument, and *qua* argument it is invulnerable.

What, then, is the origin of the paradox? It can only arise from the fundamental concept of the representation of the variables of classical physics by the operators of quantum theory. The assertion that such a representation exists is the form taken

by the Correspondence Principle in modern quantum theory, and the paradox to which I have directed attention is a definite proof that, in this form, the Correspondence Principle is false. It is false for the obvious reasons that physical characteristics cannot be simultaneously describable by classical variables and by quantum operators, and hence that there cannot be any rigorous one – one correspondence between these two systems. Trivial though this conclusion appears, it is sufficient to require the complete revision of the greater part of the quantum theory, which at present still leans heavily on the crutches of the Correspondence Principle.

G. TEMPLE.

King's College,
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July 1.

Isotopic Constitution of Uranium

THE analysis of uranium rays from the volatile hexafluoride by Dr. Aston[1] has shown a single line at atomic weight 238. The element appeared to be simple to at least two or three per cent, but its properties were not favourable for study in the gas discharge. As uranium is of great importance for the subject of radioactivity, the spark source described in NATURE of April 6 (135, 542) was tried with uranium metal and gold as electrodes, and also with an electrode made by packing a nickel tube with pitchblende. It was found that an exposure of a few seconds was sufficient for the main component at 238 reported by Dr. Aston; but in addition on long exposures a faint companion of atomic weight 235 was also present. With two different uranium electrodes it was observed on eight photographs, and two photographs with the pitchblende electrode also showed the new component. The relative intensity could be only roughly estimated on account of the irregularity of the spark, but it appeared to be less than one per cent of the intensity of the main component.

This faint isotope of uranium is of special interest as it is in all probability the parent of the actinium series of radioactive elements. In discussing Dr. Aston's analysis[2] of the isotopes in lead from radioactive minerals, Lord Rutherford[3] pointed out that the lead isotope of atomic weight 207 is probably the end product of the actinium series, so that the atomic weight of protoactinium would be 231, $(207+6\times4)$. This value has been verified by the recent chemical determination of the atomic weight by v. Grosse[4]. Protoactinium itself may be formed by α- and β-ray transformations from a hypothetical isotope of uranium, actino-uranium, with an atomic weight of 235 or 239[3]. The relative amount of actino-uranium at present on the earth would be 0·4 per cent of the uranium according to a recalculation by Dr. v. Grosse[5,6]. The present observations thus support this theory, with the atomic weight of 235 for the isotope actino-uranium. A third isotope, uranium II, of atomic weight 234 amounts theoretically to only 0·008 per cent of the uranium, and would be too faint for observation by the mass-spectrograph.

A. J. DEMPSTER.

University of Chicago.
July 12.

[1] Aston, NATURE, 128, 725; 1931.
[2] Aston, NATURE, 123, 313; 1929.
[3] Rutherford, NATURE, 123, 318; 1929.
[4] A. v. Grosse, *Proc. Roy. Soc.*, 150, 363; 1935.
[5] A. v. Grosse, *Phys. Rev.*, 42, 565; 1932.
[6] A. v. Grosse, *J. Phys. Chem.*, 38, 487; 1933.

Intensity of Polarised X-Rays

To obtain a pencil of plane-polarised X-rays as free as possible from unpolarised radiation, Barkla's original method is still the standard. The resulting beam produced by scattering an ordinary X-ray beam through 90° from its original direction is always very weak. Partial polarisation of the direct beam from an X-ray tube was found by Barkla, and Kulenkampff[1] found strong polarisation near the short wave-length limit in the general radiation. Mark and Szilard[2] found no polarisation in the fluorescent radiation even at 90°. In the scattering method some increase of intensity is found when the scatterer will give a 'powder' line for which the Bragg angle, for the strongest component of the incident radiation, is 45°.

The polarised beam got by any of these methods proved too weak for use in some experiments on the interaction of polarised X-rays and crystals. A serviceable polariser for CuK_α radiation was made by using a single crystal as the scatterer. The most intense beam was got from a single crystal of copper cut parallel to the 311 planes ($2\theta=90°\ 10'$). Serious reduction in reflecting efficiency due to distortion can be avoided by the use of a special technique for preparing the section. The results of a comparison of intensity of the beam of polarised X-rays given by such a polariser and by the standard methods are shown in the table. As an ionisation spectrometer was not available, a photographic method had to be used. An attempt was made to produce the same blackening of photographic film by each of the methods in turn under similar conditions of working of the X-ray tube and of photographic development. Each film was then measured on a Moll microphotometer and the blackening expressed as $\log_{10}(I_0/I)$, where I_0 is the galvanometer deflection when the unblackened film is before the thermopile and I is the corresponding deflection for the blackened film. The value 0·301 is for a film transmitting one half of the light incident upon it normally.

Scatterer	Density of blackening of film	Time of exposure (sec.)
Section of single crystal of copper	0·441	5
Copper powder (foil)	0·301	900
Carbon block	0·344	3,600
Wax block	0·414	4,800

Since photographic blackening by X-rays is a function of the product of the incident X-ray intensity and the time of exposure[3], the results show that the increased efficiency got by using the single crystal polariser is of the order 100 to 1000 fold. Since the polarised beam from the crystal is a directed beam, greater accuracy of setting of the apparatus is needed than for the standard methods, but the routine accuracy of X-ray crystallography suffices. With this more powerful beam, advantage can be taken, in the study of the interaction of X-rays and matter, of the vectorial properties of polarised X-rays. In one such experiment now in progress it was found that an exposure of 24 hours was necessary with polarised X-rays when an exposure of 5 min. with ordinary X-rays sufficed. Without the thousand-fold increase of efficiency the experiment was impracticable, needing apparently an exposure of nearly three years.

The University,
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W. H. GEORGE
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[1] *Phys. Z.*, 30, 513; 1929.
[2] *Z. Phys.*, 35, 743; 1926.
[3] Bouwers, *Z. Phys.*, 14, 374; 1923.

Extreme Infra-Red Absorption of D_2O, Ice and D_2O in Dioxane

THE broad absorption band observed in liquid water at about 160 cm.$^{-1}$ might be attributed to a free rotation of individual molecules, a combination frequency of near infra-red bands, or to a quasi-crystalline structure. The difference between the absorption of H_2O in the liquid and vapour states suggests the latter, and we can attribute it to either (1) hindered rotation or (2) hindered translation. This frequency being strongly infra-red active I interpreted it as due to a hindered rotation of the molecules[1]. Bernal and Tamm[2], using the model described by Bernal and Fowler[3], predict a fundamental frequency of hindered translation near 160 cm.$^{-1}$ and a fundamental frequency of hindered rotation at 480 cm.$^{-1}$. Measurements on D_2O permit us to decide between phenomena (1) and (2): for hindered rotation the frequency should be shifted by $\sqrt{2}$, for hindered translation by $\sqrt{20/18}$, or about 5 per cent.

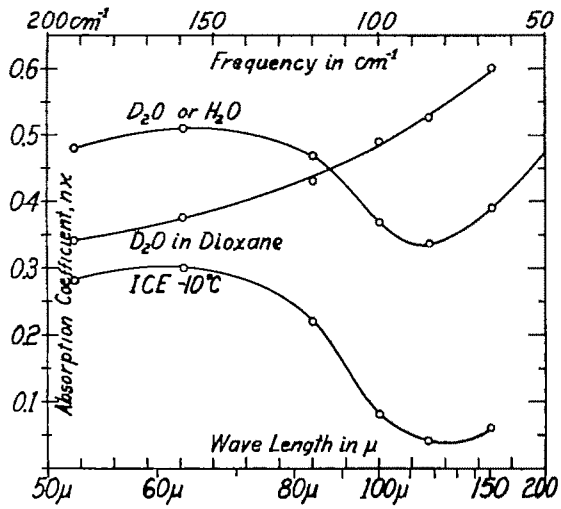

FIG. 1.

Within our experimental limits, D_2O and H_2O had the same absorption between 60 cm.$^{-1}$ and 200 cm.$^{-1}$. The absorption band near 160 cm.$^{-1}$ can therefore be assigned to a hindered translational frequency of D_2O or H_2O molecules as predicted by Bernal and Tamm. However, if this frequency were due only to a vibration of water molecules in a quasi-crystalline structure, it should be neither infra-red active nor Raman active. The difficulty might possibly be removed (using the model proposed by Bernal and Fowler[3]) by assuming that some of the four surrounding molecules are forced to follow the vibrations of the molecule at the centre by turning. This could in effect make a hindered translational motion infra-red active and also weakly Raman active, as is observed[4, 5].

The existence of the 160 cm.$^{-1}$ band in ice at $-10°$ C., as shown in Fig. 1, is additional evidence for a quasi-crystalline structure in water, and indicates that the intermolecular forces are about the same in water and ice. As is also shown in Fig. 1, the 160 cm.$^{-1}$ band disappears for water dissolved in dioxane, which confirms that its presence was due to a structure in water rather than to the individual molecules. The absorption of dioxane has been subtracted in calculating the curve in Fig. 1.

Bolla[4] reports a feeble Raman band near 60 cm.$^{-1}$. If this frequency is infra-red active, it is masked by the absorption due to the orientation of the permanent dipoles, as is best seen for water dissolved in dioxane. The absorption coefficient of water increases[6] to a maximum of 2·7 at 0·6 cm.$^{-1}$.

Absorption measurements of the hindered rotation band predicted by Bernal and Tamm[2] at 480 cm.$^{-1}$ would be experimentally difficult, but the measurements of the reflecting power[7] show a distinct maximum about 500 cm.$^{-1}$ (much stronger than that for the 160 cm.$^{-1}$ band). This frequency, if it were due to a hindered rotation, should indeed be strongly infra-red active; however, an accompanying distortion of the configuration of the surrounding water molecules seems necessary to explain the feeble Raman band observed in this region[4, 5].

I wish to thank Prof. E. K. Rideal for kindly supplying the D_2O used in these experiments.

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Laboratory of Physical Chemistry,
Technical Faculty of the University,
Brussels.
June 4.

[1] C. H. Cartwright, NATURE, 135, 872, May 25, 1935.
[2] J. D. Bernal and Ig. Tamm, NATURE, 135, 229, Feb. 9, 1935.
[3] J. D. Bernal and R. H. Fowler, *J. Chem. Phys.*, 1, 515; 1933.
[4] Bolla, *Nuovo Cimento*, 10, 101; 1934.
[5] Magat, *J. Phys.*, 5, 347, 1934.
[6] H. Rubens, *Verh. d. phys. Ges.*, 17, 315; 1915.
[7] H. Rubens u. E. Ladenburg, *Verh. d. phys. Ges.*, 10, 226; 1908.

Molecular Polarisation of Solutes and Dielectric Constant of Solvents

EXPERIMENTALLY it is indicated that the different total polarisations shown by the same solute when dissolved in different solvents are to be related to alterations in the orientation polarisations (${}_0P$) caused by replacement of one dielectric environment by another, the atomic and electronic polarisations being constant throughout such changes. Therefore the expression given by Raman and Krishnan[1] for the volume polarisation of a dielectric, namely:

$$\frac{\varepsilon - 1}{\varepsilon + 2} = \nu\left(\frac{4\pi}{3}\frac{\alpha_1 + \alpha_2 + \alpha_3}{3} + \frac{\varepsilon - 1}{\varepsilon + 2}\psi\right) + \frac{\nu}{3kT}\left(\frac{4\pi}{3}\mu^2 + \frac{\varepsilon - 1}{\varepsilon - 2}\Theta\right)$$

(cf. reference for definition of symbols) can be rewritten to show the molecular orientation polarisation (${}_0P_{\text{sol.}}$) of a polar solute at infinite dilution in a non-polar medium of dielectric constant ε as:

$${}_0P_{\text{sol.}} = \frac{N}{3kT}\left(\frac{4\pi}{3}\mu^2 + \frac{\varepsilon - 1}{\varepsilon + 2}\Theta\right).$$

Now, dividing throughout by the true orientation polarisation as observed in the gaseous state (${}_0P_{\text{gas}} = 4\pi N\mu^2/9kT$) we have

$${}_0P_{\text{sol.}}/{}_0P_{\text{gas}} = 1 + 3\,\Theta/4\pi\mu^2\,\frac{\varepsilon - 1}{\varepsilon + 2}.$$

We wish to direct attention to two points of interest which arise from this result:

(1) The sign of Θ being inversely that of the Kerr constant for the substance, this quantity is for most substances negative, and therefore their polarisations in solution should be, and in many instances have

been found to be, *less* than in the vapour states. Further, in many cases Θ can be considered as approximately equal to $-4/3.\pi.\mu^2$, whence, by substitution,

$$_{s}P_{\text{sol.}}/_{0}P_{\text{gas}} = 1 + \frac{1-\epsilon}{\epsilon+2} = 3/(\epsilon+2),$$

which is identical with the purely empirical result discussed and illustrated previously[4].

(2) The minority of compounds—for example, chloroform, ether and certain amines—which have negative Kerr constants[3], are particularly significant because *they should exhibit larger polarisations in the dissolved than in the gaseous condition.* Such experimental evidence as is available (cf. ref. 2) appears to support this. One extreme case can be quoted as an example: chloroform (Kerr[3] $B = -3 \times 10^{-7}$) at 25° has an apparent orientation polarisation in the liquid (bulk) state of 23·7 c.c. whilst the highest recorded value in the vapour state, calculated from the results of Sircar[2], is only 22·8 c.c.

Fuller information regarding the orientation polarisations in the gas phase of substances with negative Kerr constants is eminently desirable at the present time.

R. J. W. LE FÈVRE.

University College,
London, W.C.1.
June 11.

[1] Raman and Krishnan, *Proc. Roy. Soc.*, *A*, 117, 589; 1927.
[2] *Trans. Far. Soc.*, 1934, Appendix.
[3] Briegleb und Wolf, *Fortsch. Chem.*, 21, Pt. 3; 1931.
[4] Le Fèvre, *Chem. and Ind.*, April 5, 1935, p. 316; and *J. Chem. Soc.*, June, 1935, p. 773.

Coalescence in Stages between Two Drops of a Liquid

A DROP of benzene introduced into a vessel of water through a capillary tube spreads to a limited extent over the surface of galena that has been coated by any of the compounds known in flotation as collectors[1]. If now the tube be raised slowly, the benzene drop becomes elongated and then ruptures. The angle of contact being greater than 90°, a portion of the benzene remains on the mineral surface, the greater part contracts into a nearly spherical pendent drop at the end of the capillary tube, and the small portion that formed the 'waist' before breaking becomes a minute drop that rises slowly through the water. It does not immediately coalesce with the pendent drop when they meet. After a variable induction period, a very rapid change occurs, as the result of which the small drop may disappear altogether or may merely decrease in size. On occasions there may be four such diminutions in size before the drop disappears, the induction period for each being several seconds. Other organic liquids behave similarly.

A similar phenomenon has been observed with water. Small drops directed obliquely on to the surface of tap water do not immediately coalesce with it. It is presumed that the surfaces are contaminated by a thin film of grease or dust. Again, coalescence sometimes occurs in stages.

The probable explanation of these facts is that when true contact first establishes itself between the liquid in the small drop and that in the larger surface, spreading occurs so rapidly that the bubble does not fall (or rise) so quickly as its contents drain away; a waist is formed and rupture occurs before the complete drop has been absorbed. It is suggested that these phenomena would repay investigation in a laboratory equipped with a high-speed cinematograph.

IAN W. WARK.
ALWYN B. COX.

Department of Chemistry,
University of Melbourne,
Carlton, N.3.
May 11.

[1] Wark and Cox, "Milling Methods", *Trans. Amer. Inst. Min. and Met. Eng.*, 112, 189; 1934.

Statistical Tests

IN discussions on statistical tests with various Continental statisticians and users of statistical methods, I have been struck by their universal mistrust of modern statistical tests as developed by Pearson, Fisher and other workers in Great Britain. I have come to the conclusion that the main reason for this attitude is a perfectly sound reason, namely, that a test is used by many workers in Great Britain as a *simultaneous test* of the untruth of one hypothesis and the truth of the reverse hypothesis. There is *in fact* a large region in the distribution of the criterion for which neither a hypothesis nor its reverse can be assumed to be true. One or the other *is* true, of course, but the test cannot help us in coming to a decision on the matter. Judgment must be reserved. For example, we may wish to test whether a given sample differs significantly from a random sample from a normal population. Applying the χ^2 test, after finding the best fitting normal distribution, and using $p = 0{\cdot}05$, say, as the level of significance, we may find that our sample is just not significantly abnormal.

The χ^2 criterion is perfectly justifiable up to this point. It is quite unjustifiable, however, to assert that the reverse hypothesis is true, namely, that the sample *is likely* to have come from a normal population, unless we have other reasons to believe this, in which case, of course, the χ^2 test is not used as a criterion of the truth of the reverse hypothesis. Given an equal *possibility* of an infinite variety of populations, the most likely group of distributions to have given it contains all those which will give the *modal* χ^2 value for the appropriate number of degrees of freedom. All these and an infinite number of others may be considered as *likely* to have given the sample, compared to the best-fitting normal distribution, which has indeed comparatively a very small likelihood. This likelihood is sufficient, however, to prevent our assuming abnormal distribution.

It is often of scientific and practical interest to investigate whether Gauss's law or other simple laws of distribution apply to a sample. There is no doubt that the χ^2 test, as usually applied, is quite useless for this purpose, though it may be most useful as a test of *significant heterogeneity*, using a low value of P as a criterion. It seems only reasonable that but a small part of the centre of the χ^2 distribution should be used as a test of *fit*.

I believe the mistrust of British methods on the part of the statisticians of other countries to be due partly to their failure to realise that the word 'normal' is usually employed to cover samples which are likely to have arisen from populations the estimates of the mean and other parameters of which have distribu-

tions very similar to those of the corresponding normal parameters. The fact that British methods 'work' is due to the prevalence in Nature of distributions *similar* to the Gaussian rather than to any peculiar virtue in the methods themselves. I am writing this in the hope that some statistician of international repute will be tempted to treat the matter fully in some publication such as NATURE available to statisticians of all countries.

H. J. BUCHANAN-WOLLASTON.

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Philosophy and Modern Science

I DO not know whether in a brief compass I can say anything useful in regard to Dr. Jeffreys's letter in NATURE of July 20. Yet it seems a pity that the cardinal psychological distinction upon which I was laying stress[1] should be obscured by mere misapprehension and confusion.

I thought I had made sufficiently clear what I meant by the term *sensum*, namely, *that which is sensed or perceived*, in contradistinction to the *sensing* or *perceiving*. I was not in the least concerned with Russell's theory of sense-data, or as to whether most of what Russell called sense-data are or are not perceived. All I desired to insist upon was that sensing or perceiving is not identical with that which is thereby sensed or perceived. Dr. Jeffreys now tells us that what he means by sensations are such things as various patches of different shapes and colours of which he is aware when his eyes are open, and which disappear when his eyes are closed. Precisely; he is using the term sensation, as I suspected, for that which is sensed, and is ignoring, although all the while assuming (in speaking, namely, of being aware), a process of sensing.

He now maintains that sensations, so understood, seem to be immediate and not to be the result of activity on the part of the conscious subject. With the latter part of this statement I thoroughly concur; but when I am further told that sensations, or sensa, "just happen", I feel bewildered. Surely, patches of various shapes and colours do not "happen"; they simply are; what "happens" is the state or condition of being aware of them. The latter is the mental act; and it is, of course, wholly different from a bodily activity, such as that of "opening my eyes". Whether there be any process rightly describable as "merely having a sensation" is more than doubtful; but most certainly if there is, it is a case of mental activity. Not even the crudest, the most indefinite, *awareness* of a sensuous content is conceivable which does not involve the functions of discriminating and comparing, which functions, as the result of development, ultimately assume the highly evolved form of mental activity we call thinking.

Again, the statement in my letter that a concept, psychologically considered, is a way in which universals are cognised presupposes by no manner of means the existence of universals. We cognise numerous entities—numbers, for example—which are not existents. Indeed, the point I was urging was that an individual existent, such as the planet Neptune, is obviously neither a universal nor a concept. Dr. Jeffreys now informs us, "It is only when many observations are available that we can form the idea of a single body moving in a definite way; generalisation has already been applied in thinking of Neptune at all". Quite true; but what has that to do with the matter? Generalising is, in fact, involved in every act of mature perception, in my perception, for example, of the table at present in front of me; but it does not follow that the object perceived is, on that account, itself a generalisation. Dr. Jeffreys further informs us that what he calls a percept is substantially what Pearson called a construct. Well, I suppose a writer is at liberty to use a term in any sense he chooses. But it is, to say the least, unfortunate when a term with a well-recognised connotation is employed in a manner altogether contrary to its ordinary meaning. Even in popular language, the term 'concept', according to the "Oxford Dictionary", signifies "idea of a class of objects, general notion". The "idea of a single body moving in a definite way" is doubtless an idea of a highly complex object; but it is not, as such, an idea of a class of objects.

G. DAWES HICKS.

9 Cranmer Road,
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July 22.

[1] NATURE, 135, 1035, June 22, 1935.

The Carr and Price Reaction of the Fatty Acids of Cod Liver Oil after Vigorous Saponification

IT has been demonstrated[1-4] that prolonged and vigorous saponification of the mixed free acids of fish-liver oils causes remarkable changes in their chemical structure and in the absorption in the ultra-violet. When saponifying the acids of cod liver oil in this way, I observed a remarkable change in the Carr and Price reaction of these acids.

Cod liver oil was saponified for 10 minutes with ethyl alcoholic potash, and the unsaponifiable fraction extracted with ether. The fatty acids were distilled (at 0·2 mm.). They were pale yellow in colour and gave with antimony trichloride in chloroform only a yellow colour. The acids were saponified for six hours in nitrogen under reflux with an excess of amyl alcoholic potash. (The amyl alcohol was previously distilled over potash.)

The regenerated acids gave with the Carr and Price reagent a relatively strong and rapidly decreasing violet colour with absorption at 600–620 mμ and at 530–550 mμ. Measured with the Lovibond tintometer, these acids contained per c.c. 300 L.U. (Wolff) = blue value 60. The cod liver oil itself contained 70 L.U. (Wolff) = blue value 14. The substance responsible for the reaction was purified by dissolving the acids in light petroleum and filtering through a Tswett column with activated aluminium oxide. A yellow coloured zone was visible at the top, unaltered even after washing with ethyl alcohol. The pigment was eluted with dilute ethyl alcoholic potash, regenerated by acidification and taken up in ether. After evaporation *in vacuo*, a pale brown-coloured semi-solid substance was obtained. Addition of light petroleum caused a yellow precipitate and removed soluble substances, which gave a reddish brown Carr and Price reaction. The precipitate was washed several times with light petroleum and dissolved in a small quantity of acetone or chloroform. So a colourless impurity which is insoluble in acetone and chloroform could be removed. After evaporation and drying *in vacuo*, a yellow amorphous powder was obtained.

The substance possessed acid properties, a dilute solution in chloroform was yellowish green-coloured and showed by itself no definite absorption bands (absorption from ± 470 mμ down to the lower part of the spectrum). With the Carr and Price reagent a violet colour developed with absorption bands at 525–535 mμ and at 590–620 mμ. The 525–535 mμ band rapidly decreased, the reaction mixture turned blue to greenish blue and a band at 670–690 mμ became visible. The bands at 590–620 mμ and at 670–690 mμ and also the blue colour are relatively stable. The Lovibond value of the yellow substance was 75,000 (Wolff) or blue value 15,000. From 15 gm. of fatty acids a few milligrams of the yellow product were obtained.

Different samples of cod liver oil and halibut liver oil acids showed this reaction with the antimony trichloride reagent. It was not observed with the acids of butter fat or arachis oil, or with carotene, cholesterol or ergosterol.

Further investigations are in progress.

A. EMMERIE.

Laboratory of Hygiene,
University of Utrecht.
June 20.

[1] Dann and Moore, *Biochem. J.*, 27, 1166; 1933.
[2] Dann, Booth, Golding and Kon, *Biochem. J.*, 29, 138; 1935.
[3] Edisbury, Morton and Lovern, *Biochem. J.*, 27, 1451; 1933.
[4] Edisbury, Morton and Lovern, *Biochem. J.*, 29, 899; 1935.
[5] Gillam, Heilbron, Hilditch and Morton, *Biochem. J.*, 25, 30; 1931.

The Metabolism of Retina

SIGNIFICANT differences of the *normal* metabolism of tissues either in Ringer bicarbonate or in phosphate solution have so far not been reported[1,2]. On the other hand, the contradictory results obtained by Dixon and Elliot[3] and Alt[4] respectively concerning the hydrogen cyanide stable residue of the respiration of liver slices have been explained by the use of different media. Nearly complete inhibition occurs in Ringer bicarbonate while a considerable residue remains in phosphate solution or in Ringer without bicarbonate.

The study of the metabolism of retina and tumours has shown the following results:

The respiration of rat's retina and Crocker mouse-sarcoma 189 in bicarbonate Ringer is about twice as high as in phosphate Ringer.

	Q_{O_2} in bicarb.	Q_{O_2} in phosphate
Retina	32	17·5
Tumour	12–18	6–9

While the respiration of the tumour is inhibited in both media by about 90 per cent by hydrogen cyanide $n/1{,}000$–$n/500$, *the respiration of retina is inhibited* by

Retina, hydrogen cyanide $n/1000$

	Q_{O_2}	$Q_M^{O_2}$	$Q_M^{N_2}$
Bicarb.	32–35	88	88
Phosphate	8	—	—

the same hydrogen cyanide concentrations *only in phosphate Ringer* but *not inhibited at all in bicarbonate Ringer*. The Pasteur reaction in this case is completely inhibited, the aerobic glycolysis becomes equal to the anaerobic. Hydrogen cyanide, therefore, in bicarbonate media acts on retina as ethylcarbylamine[5] on other glycolysing tissues. The anaerobic glycolysis is not affected. The inhibiting effect of phosphate and of hydrogen cyanide in phosphate on the respiration is reversible.

The natural thickness of the retina allows the measurement of its respiration at very low oxygen tensions. In nitrogen with 5 per cent oxygen, the respiration in phosphate remains still normal ($Q_{O_2} = 17{\cdot}5$) and under our experimental conditions 95 per cent carbon monoxide with 5 per cent oxygen leads to no inhibition of the respiration of the retina.

H. LASER.

Molteno Institute,
University of Cambridge.
June 30.

[1] O. Meyerhof, "Die chemischen Vorgänge im Muskel.", p. 53. (Springer, Berlin, 1930.)
[2] F. Dickens and F. Simer, *Biochem. J.*, 25, 985; 1931.
[3] M. Dixon and K. A. C. Elliot, *Biochem. J.*, 23, 812; 1929.
[4] H. L. Alt, *Biochem. Z.*, 221, 498; 1930.
[5] O. Warburg, *Biochem. Z.*, 172, 432; 1926.

Coagulation of the Blood as a Chain Reaction

WITH reference to the letter of Dr. Albert Fischer published in NATURE of June 29 (135, 1075), readers of this journal may be interested to be reminded of the following quotation from a paper by C. Delezenne, published in *Ann. de Physiol. et de Physicochim. biologique* (2, 537; 1926):

"Outre la faculté essentielle qui le définit, le fibrinferment possède encore la curieuse propriété, découverte par BORDET et GENGOU, de faire lui-même naître le fibrinferment, ou tout au moins d'en accélérer considérablement la production, lorsqu' on l'ajoute à un milieu qui en renferme tous les générateurs."

This sentence and what follows it fully substantiate the theory of blood coagulation as a chain-reaction described by Dr. Fischer.

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June 29.

Fish and Rabbit Liver Glycogens

LIVER glycogen from fish of the genus *Gadidæ*, first isolated and described by Bell and Young[1], was subjected to methylation by the procedure of Haworth and Percival[2]. The product showed a methoxyl content of 45·5 per cent (maximum) and was identical with the corresponding derivative from highly purified rabbit liver glycogen in all its properties including $[\alpha]_D$ in water +208° and in chloroform +209°. Hydrolysis with a mixture of aqueous hydrochloric and acetic acids, followed by separation of the cleavage products, yielded an amount of analytically pure tetramethylglucopyranose corresponding to 9·1 per cent of the starting material, while control experiments on methylated rabbit liver glycogen gave 9·5 per cent. Both these values correspond to a molecular magnitude of 12 glucose units for the glycogen molecule, and are in agreement with the findings of Haworth and Percival for commercial rabbit liver glycogen. The methylated glycogens are

further identical with respect to the colour developed with iodine, a deep red-brown, although, as Bell and Young found, the parent substances differ in this respect.

Results recently obtained by Bell and Kosterlitz[3] reveal further identity by examination of acylated derivatives of the two glycogens, and of the glycogens regenerated from these derivatives. It is therefore concluded that fish and rabbit liver glycogens are very probably chemically identical.

These results will be communicated fully through the usual channels.

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Marischal College,
Aberdeen.
June 28.

[1] *Biochem. J.*, **28**, 882; 1934.
[2] *J. Chem. Soc.*, 2277; 1932.
[3] In the Press.

Homology of the Female Periurethral Glands and the Prostate

So early as 1853, Virchov assumed, on the evidence of histological similarity, that the minute periurethral glands, found in the human female in the neighbourhood of the urethra, are homologues of the male prostate.

The following experiments made by us give experimental confirmation of this and some similar observations, and of the homology of the periurethral glands in the female rat with the ventral lobe of male prostate. The diol of androsterone ($C_{19}H_{32}O_2$, a derivative of male sexual hormone) prepared by Ruzicka was injected into ovariectomised rats for three weeks in doses of 175–700 γ a day. On dissecting the vagina and uterus of these rats, glands, not normally seen in the rat, were found on the vagina, at the base and in front of the bladder. Macroscopically, these glands had the appearance of the ventral lobe of the male prostate. The largest gland measured 6 mm. × 4·2 mm. × 2·2 mm. The addition of œstrone to diol injections did not prevent the development of the 'female prostate'. Microscopical examination revealed a structure typical of the normal ventral lobe of the prostate of the male. This glandular tissue was found in some of the normal and ovariectomised uninjected rats, but only on histological examination; it was in a rudimentary condition, with atrophic cells.

Thus the name 'female prostatic gland' could be used instead of 'female periurethral glands', in order to emphasise the homology of these glands in the male and female, in the same way as the name 'utriculus masculinus' is used to show that this gland is homologous with the uterus of the female.

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July 9.

Depigmentation, a new Dietary Deficiency Disease, cured by Copper

IN a preliminary communication[1] a short description and two figures were given of a peculiar deficiency disease, involving depigmentation and occurring in young, pigmented rats. The only author who has, so far as I know, published a description of the same manifestations in rats, is Hartwell[2]. She attributed these symptoms to deficiency of tryptophane and tyrosine in the diet.

Hitherto I have succeeded in producing a similar syndrome in young as well as in adult rats, young cats and young or adult rabbits. In my opinion, young rats are most susceptible to depigmentation; furthermore, they are susceptible during the whole year. Hartwell, however, could not produce depigmentation in rats during the winter season.

The influence of the feeding of many vitamins and minerals (Cu, Fe, Mn, Zn, Co, Ni, Na, K, Ca, Mg, F, Cl, I, P, S) was tested, separately and together: copper appeared to be the only active principle required for prevention or cure. The dosage must be much higher than for cure of anæmia, namely, 0·02–0·12 mgm. per diem for prevention, and 0·07–0·24 mgm. per diem for cure of the depigmentation. The minimum dosage required may thus vary considerably within these limits, in consequence of its availability and of the anti-copper effect of certain (growth-promoting) food-factors, which should always be present to some extent in a satisfactory diet.

Growth in itself may also promote depigmentation.

Loss of fur bears no relation whatever to the onset of depigmentation. It is cured by entirely different dietary factors (vitamin B_2 complex, cystine, residue factor of yeast or liver) and does not occur in rats fed on rations which are deficient in copper only. On the other hand, bald and depigmented rats may be cured by addition of copper so far as their colour is concerned, and the bald areas do not recover in this way.

F. J. GORTER.

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Delft, Holland.
June 11.

[1] Gorter, NATURE, **134**, 382; 1934.
[2] Hartwell, *Biochem. J.*, **17**, 547, 1923.

Vitamin C in Lower Organisms

THE vitamin C staining reagent (acetic acid – silver nitrate) has been applied to certain protozoa, bacteria, moulds, lichens and algæ.

Various ciliates and *Chlamydomonas* were concentrated by centrifuging, washed with distilled water, and then fixed with the acetic acid silver nitrate solution of Giroud and Leblond. Sections of these protista showed the presence of small black granules scattered in the cytoplasm without exhibiting any association with formed elements of the cell, such as the nucleus, chloroplasts, etc. The granules were rounded and each one was approximately one fifth the size of a single chloroplast in *Chlamydomonas*. Five or six granules occurred in each individual, both *Chlamydomonas* and the ciliates. In some of the latter, it was noticed that there was a tendency for the granules to aggregate round certain vacuoles. The culture medium in which these organisms had grown was tested with the indophenol reagent to ascertain whether vitamin C was being synthesised and excreted by them. No appreciable quantity of vitamin C either in the reduced or in the reversibly oxidised condition could be detected, however, in the medium.

Of the large numbers of *Bacillus coli communis* to which the vitamin C reagent was applied, a considerable percentage showed the presence of a single black granule at one end. No specimens were seen which showed more than one granule. Specimens

of *Mucor* and the blue-green mould *Penicilium* were also examined using the same solution for impregnation, and black granules were found in the mycelium and in the spores. The protoplasm in various types of Algæ, for example, *Spirogyra* (Chlorophyceæ) and *Oscillatoria* (Cyanophyceæ) was seen to contain varying numbers of fine granules. In *Oscillatoria* at the growing tip the granules were orientated in lines radiating backwards from the tip. The granules in the segments farther back were scattered irregularly in the centre of the segment In specimens of lichen examined, the algal cells contained only a few granules, but the fungal element of the lichen possessed a greater number of granules, aggregated chiefly in the centre of the hyphæ.

It is apparent, then, that in these lower forms of life there is a substance capable of reducing a reagent which in higher forms of life is specific for vitamin C. It is suggested, therefore, that this reducing substance in these lower organisms is vitamin C, in which case it may be that the very existence of living protoplasm is dependent upon the presence of this vitamin. It has been shown in Eutherian mammals, and more recently in the marsupials also, that vitamin C occurs in all the organs of the body, although varying considerably in concentration in the different tissues. It is present in high concentration in the pituitary and adrenal glands, the corpus luteum and interstitial gonadial cells, and, to a lesser extent, in the liver. It is also present in the adreno-cortical homologues of certain fishes.

The suggestion is that vitamin C is essential for the existence of living protoplasm, probably as an integral part of an oxidation reduction system. Its high concentration within certain organs may indicate a non-specific catalysis of the manufacture of the hormones of those organs.

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RUSSELL ALLEN.

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Australian Institute of Anatomy,
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Plural Nature of Vitamin B

ONE group of rats was supplied with vitamin B carriers that had been subjected to intense ultra-violet irradiation. The animals developed a severe dermatitis and died. A second group received tikitiki, an alcoholic extract of rice polishings, as the sole source of vitamin B. After some ten or twelve weeks these rats became denuded, assumed a very miserable appearance, and finally they died also.

Wheat germ oil and flavines have unique properties in treating these abnormalities. The denuded condition is healed by either hepatoflavine or lactoflavine, and the rats grow rapidly on the combination of tikitiki and flavine. Wheat germ oil is ineffective. The dermatitis is not relieved by flavines, but is healed by wheat germ oil. Growth will not be sustained unless the irradiated supplement is fortified both by wheat germ oil and flavines. Ultra-violet irradiation destroys two vitamins. One is flavine, the other is the unidentified factor required to prevent dermatitis.

ALBERT G. HOGAN.
LUTHER R. RICHARDSON.

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June 21.

Rarity of the Archaic Arachnids, Podogona (Ricinulei)

THE writer of the review in NATURE of June 29 of Mr. Savory's book on Arachnida refers to a statement made by that author with regard to the number of specimens of Podogona or Ricinulei known to exist. The number of specimens representing the thirteen living species of Podogona was estimated at thirty-two.

This figure was correct when Kastner wrote his monograph on the group in Kukenthal and Krumbach's "Handbuch der Zoologie" (1932), but in the summer of the year 1933, Mr. Ivan T. Sanderson presented a collection of no less than three hundred and seventeen specimens of *Cryptostemma sjöstedti* to the British Museum (Natural History). These Podogona were collected by Mr. Sanderson on the Percy Sladen Trust Expedition to Nigeria and the British Cameroons, 1933. Only seventeen specimens were adult, the rest being nymphs except for one six-legged larval form. Mr. Sanderson also managed to bring back twenty living specimens, which were kept alive for twelve months in an incubator in the Museum. During this time they were exhibited at the Royal Society soirée in June 1934 and at the Linnean Society, and Mr. Sanderson had a very interesting film made showing their curious gait, and the cataleptic state induced by sudden intense light or slight movement.

The acquisition of this valuable collection and the light it has helped to throw on this obscure group tempt one to quote further from Mr. Savory's book and say it ". . . is a challenge to those collectors fortunate enough to find themselves in the right neighbourhood".

SUSAN FINNEGAN.

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Surface Tension of Heavy Water

SELWOOD and Frost[1] obtained for mixtures of varying proportions of ordinary and heavy water different values of surface tension, the surface tension becoming smaller as the D_2O concentration increased. These authors compute by extrapolation that pure heavy water has a surface tension of 67·8 dyn./cm. at 20° C. No other data can be found in literature, especially no direct measurements of surface tension of pure heavy water.

When dealing with another problem, there arose a necessity of carrying out such a measurement with 99·2 per cent D_2O obtained from the Norsk Hydroelektrisk Kvaelstofaktiebolaget, of Oslo, Norway.

Radius of the capillary bore (cm.)	Surface tension of ordinary water (dyne/cm.)	Surface tension of heavy water in dyne/cm.		
		I $d = 1·1053$	II $d = 1·1048$	III $d = 1·1049$
0·013526	73·0	72·7	72·6	72·6
0·019503	72·0	72·1	71·5	71·2
0·025364	72·4	—	71·8	72·0

Preliminary experiments carried out by means of the du Nouy precision tensiometer gave for this water a surface tension value of 72·6 ± 1 dyne/cm., the corresponding value for ordinary water being 72·8 dyne/cm. More accurate measurements were made by the ascension method at 20° C., all usual

precautions being taken. The results obtained in three capillary tubes of different radii show, for three samples (I, II and III) of more than 99 per cent heavy water obtained at different periods, a surface tension of $72 \cdot 2 \pm 0 \cdot 5$ dyne/cm. As may be seen from the accompanying table, this value does not differ from that known[2] for ordinary water, within the limits of our experimental error.

Measurements have been made also with 96 per cent and 94 per cent D_2O, the figures obtained being almost the same as those previously stated; densities and ascensions compensate each other similarly as in the case of 99 per cent heavy water.

On the basis of these preliminary measurements, we are inclined to believe that the values of surface tension of heavy and ordinary water most probably are equal or, in any case, the difference is very small.

H. LACHS.
I. MINKOW.

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Free University of Poland,
Warsaw.
June 15.

[1] *J. Amer. Chem. Soc.*, 55, 4335; 1933.
[2] cf. H. Freundlich, "Kapillarchemie", vol. 1, p. 30; 1930.

Points from Foregoing Letters

H. FRÖHLICH and E. Guth claim that Temple's paradox (that if physical operators commute, Planck's constant is equal to zero), which would invalidate the greater part of the quantum theory, is due to the arbitrary way in which he chooses the product of three physical variables. Prof. Temple, while agreeing that in the case of triple products a unique form of representation cannot be derived, maintains that his deduction is as legitimate as that of Frohlich and Guth. The paradox, he considers, really indicates that physical characteristics cannot be simultaneously described by classical variables and by quantum operators.

Prof. A. J. Dempster reports the observation by the mass-spectrograph of a uranium isotope of atomic weight 235, which is probably actino-uranium, the source of the actinium series of radioactive elements.

An X-ray polariser in which a cut section of a single crystal is used as scatterer is reported by Dr. W. H. George to give a beam of intensity 100–1000 times that of the standard methods.

Observations on infra-red light absorbed by ice, by water, and by heavy water dissolved in an organic liquid (dioxane) bring additional support, according to C. H. Cartwright, for a quasi-crystalline structure of water. The evidence favours a hindered translational frequency of D_2O or H_2O molecules, together with a turning of the four molecules surrounding the central vibrating molecule.

From a formula derived by Raman and Krishnan, relating optical and electro-magnetic properties of substances with molecular behaviour, Dr. R. J. W. Le Fèvre deduces that the polarisation of most substances in solution (as shown by the effect on the dielectric constant) should be less than in the vapour state; only those with a negative Kerr (~~magneto-~~ elect. optic) constant would show greater polarisation when dissolved than in the gaseous state.

Dr. I. W. Wark and Alwyn B. Cox describe instances of drops, apparently with contaminated surface, coalescing in several stages; they consider that the phenomena would repay study by means of a high-speed cinematograph.

Many British statisticians, Mr. H. J. Buchanan-Wollaston writes, assume that a test may be used simultaneously to show the untruth of one hypothesis and the truth of the reverse hypothesis. The reasoning employed, though often giving useful results, is open to objection and has apparently led to mistrust of these methods on the part of Continental statisticians.

The blue colour given by fish liver oils with antimony trichloride in chloroform solution has been used by Carr and Price as a rough indication of the amount of vitamin A, though it is also produced by other constituents of the oils. A. Emmerie shows how the colour reaction is affected by saponification of the oils and describes a method used to obtain in concentrated form the constituents responsible for the Carr and Price reaction.

Dr. H. Laser describes how the respiration of the retina tissue of rats, and of mouse-cancer tissue, differs in phosphate and in bicarbonate media. Small amounts of hydrocyanic acid inhibit the respiration of retina tissue in presence of phosphates, but do not affect it in bicarbonate solution.

Chemical investigation of glycogen obtained from fish liver indicates that its molecule contains 12 glucose units and, according to Dr. David J. Bell, is identical with the glycogen obtained from the liver of rabbits.

Dr. V. Korenchevsky finds that, by the injection of a derivative of male sex hormone (androsterone) into female rats from which the ovaries have been removed, certain vestigial organs (periurethral glands) are stimulated to develop into a structure typical of the ventral lobe of the prostate of the male. He suggests that the two organs are homologous in the male and female.

Depigmentation in young rats described by Dr. F. J. Gorter is prevented or cured by addition of copper to the diet. He finds that the dosages required vary considerably in consequence of the availability of the copper fed to the rats and of certain dietary factors, which are always present to some degree in well-balanced rations and counteract the copper.

Vitamin C (ascorbic acid) appears to be a constituent of every living cell, according to experiments by Dr. Geoffrey Bourne and Russell Allen. Using acetic acid – silver nitrate reagent, which gives a black stain with vitamin C, they find small black granules scattered in the protoplasm in the cells of even the lowest organisms.

Further light on the plural nature of vitamin B is thrown by experiments, briefly reported by Prof. Albert G. Hogan and Luther R. Richardson, showing that alcoholic extract of rice, wheat germ oil and flavines, differ in their ability to cure dietary deficiency diseases in rats.

Dr. Susan Finnegan recalls the unique collection of 317 specimens of the rare African arachnid *Cryptostemma sjöstedti* presented to the British Museum by Mr. I. T. Sanderson and directs the attention of suitably placed collectors to the need of further specimens representing the thirteen living species of the order Podogona.

Research Items

Eskimo Migrations

THE bearing of recent researches on the vexed problem of Eskimo migration and cultures is discussed by Dr. T. Mathiassen in an article in the *Geographical Review* of July. He regards the Thule culture as originating in Asia and representative of the first Eskimo migration from west to east across Arctic America and into Greenland by Smith Sound. The Bering Sea culture of St. Lawrence Island he believes to be older than the Thule culture, and puts the Eskimo settlement of Alaska much further back than was previously assumed. Dr. Mathiassen disagrees with Mr. Birket-Smith's theory of the first peopling of Alaska from the east by Palæo-Eskimo who were derived from the primordial Eskimo on the Barren Grounds of Canada. The Caribou Eskimo are not the last survivors of these primordial Eskimo whose descendants adopted a sea culture, but rather a residual offshoot of a coastal people. The Cape Dorset culture of Labrador and the eastern shores of Hudson Bay, described by D. Jenness, would seem to be derived from the Thule culture and not from the Caribou Eskimo, but the question arises whether the people who left this culture in Labrador were not Indians rather than Eskimo.

Mixtec Indian Manuscript

MISS EMMA REH, the Washington archæologist, whose recent investigations of Mexican antiquities have aroused considerable interest, has brought to light a Mixtec manuscript, which holds out the prospect of an interpretation of the Mixtec system of picture-writing. The manuscript is now in the National Museum, Mexico City. It came originally from the State of Oaxaca in southern Mexico. According to a report issued by Science Service, Washington, D.C., it is of deerskin and is in the form of eleven folds or pleats, reading from back to front. The contents are in black and consist of pictures, glyphs and writing in the European script, the last-named feature, obviously, giving the manuscript its special value, as it is hoped that it may thereby be possible to effect a translation of the writing in pictures and glyphs. The picture-writing suggests that the manuscript is a family chronicle of a chiefly house. It opens with a picture of three figures, who evidently, to judge by their dress, are of high rank. Their names are indicated as "Two Alligator", "Four Deer" and "Nine Dog". The story begins in the Indian year "Three House" and on the second page the date 1300 appears in European figures. Up to the eighth page the names are given in hieroglyph, but on the ninth page, Spanish names, and even Spanish clothes, appear as well as the Christian cross. This change is dated 1610, and may coincide with the adoption of the Spanish honorific 'Don' and 'Doña', a privilege granted to the Indians by the Spanish crown. The record ends in 1684. It has been suggested that it may be something in the nature of a "proof of nobility", or a document similar in purpose to the 'maps' or agreements defining boundaries, some of which are known still to be in use in Oaxaca. They are never seen by any but the Indian elders.

Marquesan Shell Coronet

A PECULIAR type of head-dress from the Marquesas Islands has been presented to the British Museum by the Christy Trustees (*Brit. Mus. Quart.*, 9, 4). It resembles a coronet, and is composed of thin plaques of conch-shell and turtle-shell arranged alternately. These are attached by threads of coconut fibre to a 'woven' band of the same material. The shell plaques are left plain, but those of turtle-shell are ornamented with figures carved in low relief in the conventional style typical of Marquesan art. The main design consists in each case of a central full-faced figure, flanked by two smaller inward-facing figures in profile. Originally there should probably have been three rows of pearl-shell discs with turtle-shell rosettes attached as an additional ornament to the surface of the sennet band. These head-dresses (*paekaha*) were formerly worn on festive occasions by both sexes. Their manufacture probably originated in Fatu Hiva in the southern islands of the group. The coronets were worn in historic times with the sennet band uppermost, so that the shell plaques formed a kind of eye-shade. The carved figures were thus worn the wrong way up, which suggests that the original method of wearing was the reverse. Good early examples are difficult to obtain, and this is the first complete specimen to appear in the Museum collections. The modern degenerate version of the coronet has celluloid or vulcanised rubber in substitution for the turtle-shell, and porcelain buttons for the pearl-shell discs.

Daylight and the Feeding of Birds

THE relationship between the coming and departing of daylight and the feeding of some common birds has been discussed by George Marples (*British Birds*, 29, p. 45, July 1935). He shows that the habit is a tolerably regular one, and that amongst the birds which begin to feed before sunrise (the time anteceding sunrise by from 42 minutes to 5 minutes) are the song-thrush, mistle-thrush, redbreast, barn-owl, backbird, wren, blue tit, great-tit, chaffinch, house-sparrow; while such as begin to feed after sunrise include only the goldfinch, coal-tit and spotted flycatcher. A regular cessation of feeding in relation to sunset was also observed. A peculiarity brought out by comparison of the times recorded is, that almost invariably blue-tits commence to feed before great-tits and finish feeding later, notwithstanding that they eat the same sort of food and the great-tit has a larger body to nourish.

Crustacea of Porto Rico and the Virgin Islands

Two important papers have recently been published by the New York Academy of Sciences on the "Scientific Survey of Porto Rico and the Virgin Islands"; these deal with the Crustacea Macrura and Anomura by Waldo L. Schmitt, and the amphipods by Clarence R. Shoemaker (New York, Jan. 1935). An endeavour is made in both papers to include every species known from these two regions including St. Croix, and a brief description of generic or specific characters is given in most cases. When many species represent a genus,

useful keys are employed and at least one species of each genus is figured. 142 species, 68 genera and 24 families of macruran and anomuran Crustacea are listed, a very large number of these having been collected by the expedition, which only undertook shore and shallow-water marine and fresh-water collecting. The amphipods are not so well known; fourteen families, twenty-one genera and twenty-four species are recorded. A revision of the genus *Emerita* with a new species (the only one found in Porto Rico) has resulted in Dr. Schmitt recognising seven species, four of which are found on the Atlantic coast of America, and two on the Pacific coast, whilst he finds that the Indo-Pacific form known as *Emerita asiatica* was first named by Linnæus as *Cancer emerita*, and should now be called *Emerita emerita*.

North American Callianassas

DR. WALDO L. SCHMIDT, in his paper "Mud Shrimps of the Atlantic Coast of North America" (Smithsonian Miscellaneous Collections, 93, No. 2, 1935), describes three new species of *Callianassa* and a new variety of one of them, proposes a new name for a specimen that had been assigned to an old, inadequately described species, and gives a general survey of all species occurring on the Atlantic coast of North America, with a useful key. One of the new species, *Callianassa* (*Callichirus*) *islagrande*, somewhat resembles *C. major*, Say, but differs in the eye stalks, telson and the remarkably elongate larger chela of the male. The genus *Glypturus*, as de Man has already suggested, is shown to be so similar to *Callianassa* that the present author now no longer separates it, placing *Glypturus acanthochirus*, Stimpson, in the sub-genus *Callichirus*, which shows a number of species having the third maxillipeds approaching the *Glypturus* type, the generic characters being based on these appendages. The paper is illustrated with photographic plates showing the dorsal front view of the various species and some of the more important limbs.

Marine Worms from Hawaii

IN Bulletin 129, Bernice P. Bishop Museum, Honolulu, 1935, M. Holly describes a collection of polychætes most of which are pelagic forms of *Nereis* captured on the surface of the sea, especially by night. All the nereids except one known species are represented by epitokous forms, all of relatively small size—3–20 mm. long—which are placed in ten new species. A detailed account of their characters is given. In *Occasional Papers*, 10, No. 18; 1934, from the same Museum is a brief note by Prof. W. R. Coe on new nemerteans from Hawaii, in which he points out that the tropical and subtropical coasts bordering the Pacific Ocean have a sparse representation of nemertines as compared with the coasts of more northern latitudes. The specimens here described, collected in the intertidal zone, include three species of the genus *Baseodiscus*, one of which is described as new. In two of the species some of the efferent ducts of the nephridia lead to the cavity of the foregut and others open on the dorso-lateral surfaces of the body.

Aquatic Hemiptera of the Family Helotrephidæ

THE family Helotrephidæ is one of obscure affinities and shows the very exceptional character, among adult insects, of the head and thorax being closely fused together. Mr. W. E. China has published an important paper wherein some new or little-known species are described and figured (*Ann. Mag. Nat. Hist.*, June, pp. 593–614). At the same time the taxonomy of the family is reviewed, and stress is laid upon those characters which are of special generic and specific value. These features are listed, and will serve as a guide to future workers, and so avoid the use of lengthy, detailed descriptions which may include the enumeration of characters devoid of real diagnostic value. The paper concludes with a key to the known genera and species. This small and peculiar family, it may be added, is only known from the Orient and Central Africa.

A Disease of Coniferous Trees

EXOTIC conifers have been imported into New Zealand for half a century. They have been acclimatised, and have usually formed healthy forests of valuable timber trees. It is scarcely a matter of wonder that one or two fungus diseases have also been imported inadvertently, but these have largely been controlled by avoiding unsuitable sites and high altitudes. A rather more severe disease made its appearance in 1929, and has been studied in detail by Mr. T. T. C. Birch ("A Phomopsis Disease of Conifers in New Zealand". N.Z. State Forest Service Bulletin No. 7. Govt. Printer, Wellington, N.Z. 1*s*. 9*d*. net. Pp. 30. 1935). The causal fungus, *Phomopsis strobi*, produces a canker upon the stems and makes the terminal shoots wilt. Young trees of *Pinus radiata*, *P. muricata* and *P. canariensis* are the hosts, but infection only occurs in late winter when unseasonable frosts overlap the growing season of the susceptible species. Cultural and morphological characters of the fungus have been investigated, and conditions of infection have been demonstrated by extensive experiment. Eighteen half-tone illustrations elucidate the structure of the fungus and portray the symptoms it produces.

Pests and Diseases of Sugar-Beet

THE Ministry of Agriculture and Fisheries has added another volume to its series of monograph bulletins on plant diseases ("Pests and Diseases of the Sugar Beet", Bulletin No. 93, pp. 58, April 1935, 1*s*. 6*d*. net. H.M. Stationery Office). The insect and other pests have been described by Mr. F. R. Petherbridge, whilst the fungus and virus diseases are treated by Mr. H. H. Stirrup. These two workers made an extensive tour of the chief sugar-beet growing areas in most of the countries of central and northern Europe, and the bulletin describes the information they collected. Most of the Continental pests are also troublesome in Great Britain, but the beet leaf bug (*Piesma quadrata*), the meadow moth or webworm (*Loxostega sticticalis*), sugar-beet weevils (*Bothynoderes* sp. and *Otiorrhynchus ligustici*) and the beet eelworm (*Heterodera schachtii*) have not yet appeared here. The virus diseases known as 'yellows' and 'crinkle' also seem to be mainly of Continental occurrence. An exhaustive list of English diseases and pests is given, each malady being described in detail. One of the most pleasing features of the volume is the publicity given to various Continental methods of control. English readers will be interested in a machine furnished with four rotary brushes which gently remove the eggs of the beet fly (*Pegomyia betae*) from their intended victims. Twenty-six half-tone illustrations help to render the bulletin an attractive and clear exposition of the subject.

The Photographic Objective

AN interesting account of the development of the photographic lens was given recently as an address to the Physical Society by W. Taylor and H. W. Lee (*Proc. Phys. Soc.*, May). The ordinary photographic lens has employed exclusively spherical surfaces, and successive improvements have removed one after another of the aberrations. The article describes the achromatic doublet, Lister's combination of doublets to correct coma, the Wollaston meniscus construction to correct astigmatism, and the combination of meniscus lenses to correct distortion. It next became necessary to increase the aperture of the lens, and the Petzval portrait lens appeared, followed by the 'rapid rectilinear' and the anastigmats using the new Jena glasses. H. D. Taylor in 1893 broke away from the traditional line of development and introduced an anastigmat with only three lens elements. Modern lenses are descended either from the Jena anastigmats, the Petzval lens or the H. D. Taylor lens. Diagrams of a number of modern lenses are given, including the Zeiss $f/0\cdot85$ lens (derived from the Petzval), various British lenses working up to $f/1$, and special variable focus and telephoto lenses. There is a list of references to patents.

Molecular Polarisation in Solution

IT is now known that the dipole moment of a substance measured in solution is influenced by the nature of the solvent, and some empirical rules have been proposed with the object of correcting for the solvent effect. By the examination of a number of experimental results, R. J. W. Le Fèvre (*J. Chem. Soc.*, 773; 1935) concludes that the expression ${}_0P_1/{}_0P_2 = K(\epsilon_2 + 2)/(\epsilon_1 + 2)$, where ${}_0P_1$ and ${}_0P_2$ are the orientation polarisations of a solute molecule in two media of dielectric constants ϵ_1 and ϵ_2 respectively, appears to be valid over a wide range of ϵ values. It satisfactorily includes the polar solvents chloroform, aniline and chlorobenzene, whilst a rule previously given by Jenkins that the total polarisation is inversely proportional to ϵ fails in this respect. A rule proposed by Muller, that ${}_0P_{\text{soln.}}/{}_0P_{\text{gas}} = 1 - k(\epsilon - 1)^2$, is found to hold only for solvents of low dielectric constant, for which $k = 0\cdot075$; it fails for chloroform ($k = 0\cdot032$) and chlorobenzene ($k = 0\cdot035$). The recorded data show that a non-polar solute has much the same molecular polarisation in all solvents: only polar solutes exhibit appreciable alterations. Since the sum of the atomic and electronic polarisations of a substance is usually practically independent of its state of aggregation, these differences are wholly referable to the orientation polarisation, the variations of which are now shown to be simply related to the dielectric constant of the medium (see also p. 181 of this issue).

Action of Calcium Carbide on Methyl Alcohol

STATEMENTS occur in chemical literature to the effect that, when free from water, alcohols do not react with calcium carbide. So far as methyl alcohol is concerned, this seems to be erroneous. The results of experiments by Prof. A. Contardi and Dr. B. Ciocca (*Rend. R. Ist. Lombardo Sci. e Lett.*, 68, parts 1–5) show that absolute methyl alcohol acts readily on powdered calcium carbide. The reaction begins even at the ordinary temperature and gives rise to calcium methoxide and acetylene, no homologues of which are formed. It is, therefore, evident that the determination of water in mixtures of hydrocarbons and alcohols by measuring the acetylene formed by their interaction with calcium carbide will not give trustworthy results unless methyl alcohol is absent. The reaction described furnishes a simple means of obtaining calcium methoxide, the preparation of which is otherwise a laborious operation.

Carob Flour as a Foodstuff

IN parts 1–5 of vol. 68 (1935) of the *Rendiconti of the Reale Istituto Lombardo di Scienze e Lettere*, Prof. Adriano Valenti, of the University of Milan, gives the results of experiments in which rats and dogs were fed with carob germ flour, either raw or roasted, and in some cases boiled with water. The flour, prepared by grinding finely the germs of the carob seeds, has a sweetish taste and adheres to the palate like a gummy material. Its percentage composition was found to be: water, 8·95; proteins, 55·30; fats, 5·21; lecithin, 1·34; ash, 6·70; cellulose, 2·32; carbohydrates, 20·18. It thus appears to be richer in protein than any other food of vegetable origin. The biological experiments show, nevertheless, that it is tolerated perfectly as a food by animals. With none of the rats (26) was any ill-effect observed, and regular increase in weight occurred, particularly with young, growing animals. The rats compared well with those of a second group fed on a diet of bread and milk. Similar results were obtained with two dogs, one of which was fed, first on bread and water, then on the carob flour, and later on bread and water again; with the other dog, part of the bread in the initial and final stages was replaced by horseflesh.

Lunar Heights and Topography

MESSRS. MCMATH, Petrie and Sawyer have developed a new technique for investigating lunar topography at the McMath-Hulbert Observatory of the University of Michigan (*Publications Obs. Mich.*, 6, No. 8). They find that an isolated determination of the height of a lunar peak, derived from a measured shadow length, is of little significance, on account of the rugged nature of the country over which the shadow is passing. The Michigan workers investigate the variation of these relative altitudes with changing shadow lengths, and so determine the topography of the neighbouring peaks and crater walls and secure the average elevation of such points above the surrounding country. Motion picture negatives are used; these are exposed in a modified motion picture camera attached to the 10½ in. Cassegrain reflector. A typical set of exposure times runs from 24·0 sec. to 17·9 sec. with an interval of 4·0 sec. between exposures. After development, the negative is run through a projector which magnifies the picture to a scale of 1·15 mm. per second of arc on the moon. A profile of a section through the crater Theophilus is given by the authors. The outer ramparts are 15,000 ft. and 14,000 ft. and the central peak 7,500 ft. above the adopted datum level, below which the floor of the crater sinks 1,000 ft. in places. This section through the crater is 65 miles from rampart to rampart. The uncertainty is given as being ± 125 ft. for the elevation of a peak 16,000 ft. above the average of the terrain in its vicinity.

ERRATUM: Referring to the paragraph entitled "Sex and Cultural Status" in NATURE of July 27, p. 149, Dr. J. D. Unwin informs us that the word "zooistic" should read "zoistic" throughout.

The Origin of Optical Rotatory Power

By Prof. T. M. Lowry, C.B.E., F.R.S.

PROF. MAX BORN'S paper on the "Theory of Optical Rotatory Power", which was read at the Royal Society on February 7 and is published in the *Proceedings* for May 1, 1935, is of first class interest and importance, since it provides an adequate solution of one of the most difficult problems in optics.

More than a century ago, Fresnel suggested that optical rotatory power was caused by the unequal velocities of transmission of circularly polarised light of opposite signs; and by a brilliant piece of experimental work he established the real existence of *circular double refraction* in quartz; but his tentative suggestion that the optical rotation of rock crystal "cannot be reconciled with complete parallelism of the molecular lines", and must therefore depend on a spiral arrangement of these layers, cannot be extended to optically active liquids. It was therefore left to Pasteur to recognise in the phenomenon of *dissymmetry* (that is, the inability of a figure to be superposed on its image in a mirror) the characteristic feature of right-handedness and left-handedness, which determines the existence of optical rotatory power in crystals and in liquids, and finds its simplest expression either in a spiral or screw-like structure or alternatively in an irregular tetrahedron.

Equations expressing the influence of wave-length on rotatory dispersion were developed in 1900 by Drude; but these were based primarily on an intuitive recognition of the correct mathematical form of the equations; and, although Drude pointed out that "a dissymmetrically isotropic medium would result if all the molecules were irregular tetrahedra of the same kind", he made no attempt to prove that his conception of *ions vibrating in helical paths* would actually give rise to optical rotation. So recently as 1916, therefore, Gray was justified in complaining that the chemical and physical theories of optical rotatory power "have not been tied together; it has not been shown why the asymmetric molecule should give rise to these particular equations".

The missing link was supplied in 1915 by Born's theory of *coupled vibrators*. The form of *coupling* suggested by Born is of the simplest and most inevitable character, and has been adopted almost universally by subsequent workers in the same field. It is merely an application of the phenomenon of electrical resonance, and implies that, when an electrically charged particle is set in vibration, for example, by an incident light-wave, it sends out a secondary wave, which acts upon neighbouring particles in just the same way as the original light-wave. The difficulty of the problem of optical rotatory power arises from the fact that rotation of the plane of polarised light is a *third-order effect* which does not appear until *four* particles have taken part in this process of resonance. No rotation is therefore produced until the original vibration has been handed on from A to B, C and D; and even then the effect is a precarious one, which vanishes if the four particles lie in the same plane, or if in any other manner a plane or centre of symmetry is created, for example, by making two of the particles identical. In these circumstances the calculation of optical rotatory power proved to be such a formidable task that it was only attempted twice in a period of twenty years; and even then one of these laborious calculations of the rotatory power of a *crystal* was vitiated by a numerical error, which has not yet been put right.

The four coupled vibrators of Born's theory obviously correspond closely with the four dissimilar radicals which give rise to optical rotatory power in the simplest optically active molecules, namely, those molecules which contain an asymmetric carbon atom of the type $C\,R\,R'\,R''\,R'''$; but the calculations of the rotatory power of an asymmetric *molecule* on the basis of Born's theory are so difficult that they have never even been attempted. Two attempts have been made, however, to simplify this extremely complex problem. Thus S. F. Boys, by ignoring the characteristic frequencies of the vibrators, was able to calculate the rotatory powers of four simple alcohols and amines, from the radii and the refractivities of the radicals; and values of these quantities were

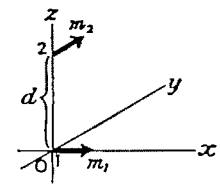


FIG. 1.* Kuhn's simplified model of a dissymmetric molecule.

found which, when inserted in an extremely complex function of the linear dimensions of the molecule, and multiplied by a simple product of the refractivities and other appropriate constants, gave a remarkable concordance between the observed and calculated specific rotations. On the other hand, Werner Kuhn, in 1929, applied Born's theory of coupling to a simplified molecular model consisting of two *linear vibrators*, moving at right angles to one another (Fig 1). Optical rotatory power then occurs as a *first order effect* and can therefore be expressed by much simpler formulæ. He showed that his model gave the formulæ for rotatory dispersion which had already been developed by Drude and Natanson, and that these formulæ then had a self-consistent basis, whereas the spiral vibrators, which Drude suggested as a justification of his formulæ, do not actually give rise to any rotatory power at all.

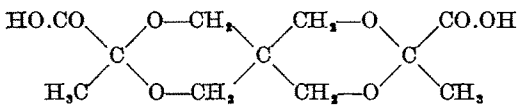
The postulate of a linear vibrator implies that the ellipsoid of elasticity is reduced to a straight line, so that the particle is able to move to and fro in one given direction, but is so rigidly confined to this linear path that no polarising force, however powerful, is able to make it move in any other direction. Such a conception differs very widely from the relatively flexible electronic systems which are found in chemical

* Figs. 1, 2 and 3 are reproduced by courtesy of Messrs. Longmans, Green and Co., Ltd., from Lowry's "Optical Rotatory Power" (1935).

molecules. It is perhaps approached rather remotely in substances like benzoquinone, the crystals of which contain giant molecules of indefinite extension in one dimension, along which they exhibit abnormally high refractivities; but substances like amyl alcohol give no hint of any similar strong anisotropy. Moreover, the presence of *four* dissimilar radicals appears to call inexorably for a system of *four* vibrators; and calculations based upon a model containing only *two* vibrators can only have a remote relation to the properties of real molecules of this type. Whilst, therefore, Kuhn's simplified model has provided a new basis for the dispersion formulæ of Drude and Natanson, it does not appear to be capable of direct application to the asymmetric carbon atom, the rotatory power of which must still be treated as a third-order effect in accordance with the original conceptions of Born.

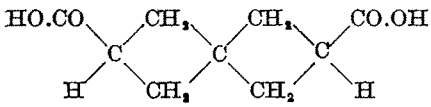
More favourable conditions occur in certain spiro-compounds, which are not asymmetric (since they possess a two-fold axis of symmetry) and do not contain an asymmetric carbon atom, but which can nevertheless be prepared in optically active forms, since they possess the essential property of molecular dissymmetry, that is, the molecule can exist in two mirror image forms which are not superposable on one another. Three such molecules have been studied in this connexion.

I. *Erythritoldipyruvic acid*, resolved by Boeseken and Felix (*Ber.*, 56, 1855; 1928).



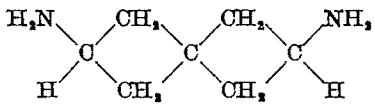
$[\alpha]_D = \pm 4°$.

II. *Spiroheptanedicarboxylic acid*, resolved by Backer and Schurink (*Proc. Akad. Wiss., Amsterdam*, 31, 370; 1928).



$[M]_D = +2°$.

III. *Diaminospiroheptane* resolved by Pope and Jansen.



$[M]_{5461} = +18°$.

In each of these compounds the two halves of the molecules are crossed, that is, if the right-hand ring is in the plane of the paper, the left-hand ring is in a plane at right angles to it, since the central carbon atom has a tetrahedral and not a planar configuration. The planes which contain the terminal radicals COOH and CH_3, COOH and H, or NH_2 and H, are therefore also at right angles to one another. These two rectangular planes can be compared with the directions of the two linear vibrators in Kuhn's original model, and on this basis he has made a detailed study of Boeseken's spiro-acid I. For this purpose he has considered the two —CO.OH groups as linear vibrators, displaced from the central axis of the molecule in directions at right angles to one another (Fig. 2), and has thus been able to calculate the rotatory power of the molecule.

This figure has the demerit of dealing with only one of the two radicals in the system CH_3—C—CO.OH, the 'crossing' of which produces the dissymmetry of the molecule. Born, on the other hand, has deduced a formula for the rotatory power of a system of four vibrators, *A*, *B*, *A*, *B* (Fig. 3), in which *both* radicals play a part and neither of them need be assumed to be strongly anisotropic. This formula has been applied to the spiro base of Pope and Jansen, where there are good reasons for thinking that spacial dissymmetry, and not the anisotropy of the H and

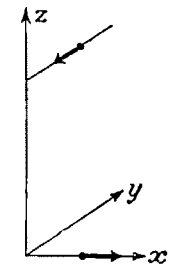


FIG. 2. Coupled vibrators in a dextrorotatory molecule.

NH_2 radicals, is the principal factor in producing the optical rotatory power of the molecule. Results of the right order of magnitude have been obtained; but these are merely guesses, and the principal importance of the formula lies in its application to the *relative* magnitudes of the rotatory power of related compounds, rather than in attempts to predict the *absolute* rotatory power of any of them. The latter must always be difficult, since the formula involves the *eighth power* of the distance between the two vibrators, the *sixth power* of their frequencies and the *square* of the strengths of their absorption bands. On the other hand, if we compare a series of spiro-compounds containing, for example, the radicals

—NH.CO.NH_2 —NH.CO.CH_3 and —NH.CO.C_6H_5

we can now recognise that their rotatory powers are definite functions of three well-defined properties of

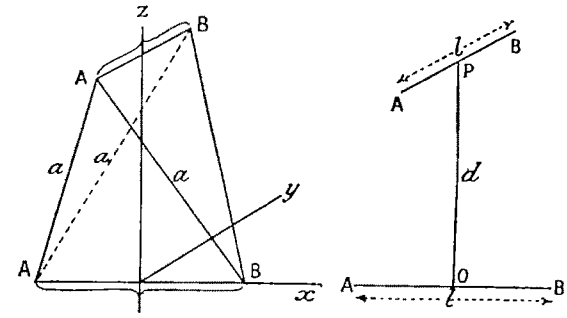


FIG. 3. Born's molecular model.

the radical, and their correlation becomes an experimental problem of very great interest. Unfortunately, the frequencies of the simplest compounds lie in the Schumann region, for which very few data are yet available; but no great increase of complexity is needed in order to bring the frequencies within the range of easier experimental observation; and, on the other hand, the Schumann region is rapidly being opened up to research, so that progress on the lines suggested by Born's theoretical work need not be long delayed.

A Note on Stereoscopic Photography

By Dr. John R. Baker, Department of Zoology and Comparative Anatomy, Oxford

IT is sometimes stated that in the stereoscopic photography of near objects it makes no difference at all to the images whether the cameras are placed parallel to one another, or convergent upon the object.

In Fig. 1 the object to be photographed has three distinct points upon it, A, B and C. The thick black

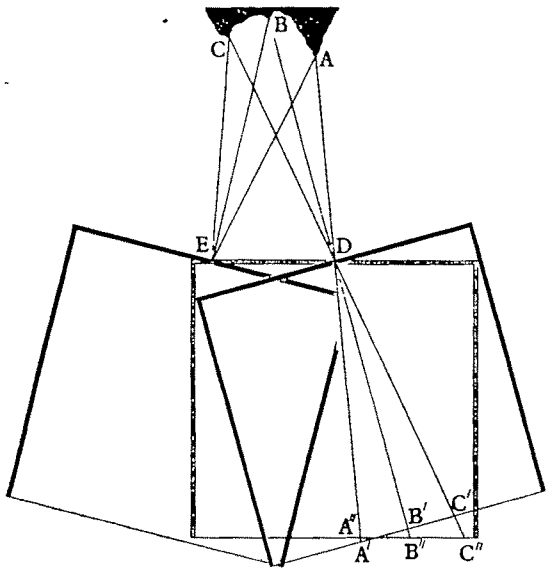


FIG. 1.

lines indicate the outlines of the camera in its two positions for obtaining convergent views of the object. (The angle of convergence shown in Fig. 1 is purposely made greater than the greatest angle of convergence possible with normal vision, so as to exaggerate the point that is to be made.) An exactly similar camera is also shown in the position it would occupy for the right-eye view, if photographs were going to be taken with parallel cameras. The outline of this camera is indicated by dots between lines. For the sake of simplicity pin-hole cameras are represented. The apertures of both pairs of cameras are at D for the right-eye view and at E for the left-eye view.

The right-eye convergent camera produces images of the points A, B and C at A', B' and C'. The right-eye parallel camera produces the images at A'', B'' and C''. Now $A'B'$ exactly equals $B'C'$, while $A''B''$ is less than $B''C''$. Therefore the view obtained with the convergent camera is not the same as that obtained with the parallel camera.

Which is the proper position of the camera for the representation of normal binocular vision as closely as possible? Imagine an eye situated at D. The owner of the eye would notice that the angle subtended between A and B was exactly equal to the angle subtended between B and C. In making an accurate drawing of the appearance of the object from his viewpoint, he would therefore make AB exactly equal to BC on his sheet of paper. This is what the convergent camera does. The convergent camera therefore gives the proper representation of the object.

The parallel camera has the advantage of giving a larger field of view in focus at the same time, if lenses of wide aperture are used and if the object presents a more or less flat surface at right angles to the axis of the cameras; but its image is not absolutely accurate. It must be remembered that in stereoscopic photography one is relying for one's effects upon minute differences between the two prints, and extreme accuracy is therefore important if a truthful appearance is to be given.

The facts stated in this note give support to the tilting-stage method of stereo-photomicrography, for in this method the two views are convergent. The other method, in which the object is photographed first at one side of the field of view and then at the other, and the two photographs treated as a stereoscopic pair, is equivalent to the use of parallel cameras.

International Co-operation in Astronomy

THE International Astronomical Union held its fifth general assembly at Paris on July 10–17, at the Centre Marcelin Berthelot, when nearly three hundred astronomers were gathered together from twenty-seven different countries. The President of the French Republic was present at the opening ceremony, when addresses of welcome were given by the Minister of Public Instruction, the president of the French National Committee of Astronomy (M. de la Baume Pluvinel), the director of the Paris Observatory (M. Esclangon) and replied to by the president of the Union, Prof. F. Schlesinger. During the meeting the adhesion of three new countries, U.S.S.R., China and Yugoslavia, was announced; with the growing number of countries supporting the Union it was found possible substantially to reduce the unit of subscription from the different countries, without hindering the work which the Union has already undertaken to support.

A great part of the value of the meeting lies in the informal discussions between small groups which were possible at some of the social gatherings organised by the generously hospitable French hosts, such as the visits to the observatories at Meudon and Paris. But the work of the Union is done mainly at the meetings of thirty-one committees which

examine schemes of co-operative work in the different branches of astronomy. One of the features of the present meeting was the number of joint meetings of commissions, which after dealing with their own special work, discussed jointly borderline problems where their common interests were concerned. Thus the commissions on ephemerides, meridian astronomy, and the movements and positions of planets, asteroids and satellites combined to discuss and press for further experimental work—to be followed later by international co-operation schemes for the determination of systematic corrections to star positions from observations of minor planets. To the commissions on notations and ephemerides were referred two resolutions on the symbols at present in use for time, which had been sent in by two national committees on astronomy. They recommended, and the Union adopted their point of view, that the symbol G.C.T. for Greenwich mean time reckoned from midnight should be dropped and that the symbol U.T. (Universal Time) should be used instead.

A move of the Bureau of Latitude Variation from Mizusawa to Naples on the coming retirement of Dr. Kimura was decided upon. Special tributes were paid to Kimura's work and he was made a *Président d'Honneur* of the commission on latitude, a similar compliment being paid to Sir Frank Dyson by the commission on meridian astronomy. The commission on spectrophotometry directed attention to the fundamental importance of producing photographic plates of uniform sensitivity over the surface, and urged further work on this point at the research laboratories of the various plate manufacturers. The physical study of comets was removed from the commission on planets and satellites, and in a general rearrangement of subjects the zodiacal light, the night sky and related subjects were grouped with meteoric astronomy, while novæ were given a special sub-commission in the commission on stellar spectra. The commission on lunar nomenclature, which has completed its work and published a map of the moon with a list of lunar formations, has been replaced by a new commission on the moon to deal also with occultations and physical researches.

Among the resolutions adopted on the recommendations of the committee on stellar statistics we may mention a definite choice of the galactic pole at $\alpha = 12^h40^m$, $\delta = +28°$ (1900·0), the position used in Ohlsson's tables of galactic co-ordinates. In solar physics resolutions were adopted for co-operative work on line profiles, for the publication of characteristic solar numbers of the sun separately for the four quadrants, N.E., N.W., S.E. and S.W., and for observations of active prominences at short intervals by a number of different methods. A number of technical resolutions on star positions cannot very well be given here but mention may be made of a resolution to issue a supplementary list of observatories and astronomers, of alterations in the cipher code for astronomical telegrams and of a preliminary list of notations prepared by Prof. Stromgren, the president of the commission on notations, and left until the next general assembly for further discussion and examination by those interested.

The volume of draft reports prepared by the presidents of commissions, well above two hundred pages in length, contains much valuable work but can be left over for review when the complete volume is printed.

One feature of great value at the meeting was an exhibition of astronomical apparatus, photographs, spectra, etc., arranged by the French National Committee with the co-operation of observatories and optical firms. This was open throughout the meeting and proved most successful. It was organised by the Comte A. de la Baume Pluvinel and M. Jules Baillaud. The latter acted jointly with M. A. Lambert as secretaries of the local committee, and to their unstinted efforts the success of the meeting was mostly due.

At the final meeting of the general assembly the following were elected as the executive committee to hold office until the next general assembly, to be held at Stockholm in 1938: *President:* M. Esclangon (France); *Vice-Presidents:* Dr. Adams (U.S.A.), Prof. Banachiewicz (Poland), Prof. Bergstrand (Sweden), Prof. Bianchi (Italy) and Dr. Spencer Jones (Great Britain); *General Secretary:* Dr. Oort (Netherlands).

Zooplankton of the Great Barrier Reef

A NOTABLE addition to the reports of the Great Barrier Reef Expedition has recently appeared*. In the first part the validity of the collecting methods is discussed, the effect of the transparency of the water and the relative abundance and composition of the zooplankton, with a comparison of temporary and holoplanktonic animals. Oblique hauls were made to ensure large enough catches to give significant results, and vertical hauls through a water column of known depth were made to give information directly comparable with data obtained elsewhere. The methods used are shown to be reliable.

Curves of the average catches of all animals for each month in the coarse silk net oblique and vertical hauls at a position three miles east of Low Isles in the Barrier Reef Lagoon agree well on the whole. Taking the copepods alone, the agreement is even closer, the month of January being the only one where there is any considerable disagreement, when many more copepods occurred in the vertical hauls. Daylight samples compare with those taken by night in a very similar way to those taken at Plymouth. The transparency of the water, which has already been shown to have a direct connexion with the wind (Orr, Vol. 2, No. 3 of these Reports), has a considerable effect on the numbers of animals caught, the curves of abundance in both oblique and vertical hauls, of copepods, decapod larvæ and chætognaths following closely the curve of transparency. There seems to be practically no seasonal variation in

* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vol. 2, No. 6: The Zooplankton. (2): The Composition of the Zooplankton of the Barrier Reef Lagoon, by F. S. Russell and J. S. Colman; (3). A Comparison of the Abundance of Zooplankton in the Barrier Reef Lagoon with that of some Regions in Northern European Waters, by F. S. Russell. Pp. 159–201. (London: British Museum (Natural History), 1934.) 7*s*. 6*d*.

numbers of copepods and decapod larvæ although there is one in the chætognaths.

Copepods, as is the case throughout the world, are the most abundant animals in the plankton. Here they form 71 per cent of the zooplankton in the vertical hauls, and this is supported in the oblique hauls, where they form 69·1 per cent. Other animals of importance were tunicates (Appendicularians and Thaliacea), chætognaths, molluscs (Pteropoda, Heteropoda and larvæ), echinoderm larvæ (November and December), ostracods (March and July), decapod larvæ and Siphonophora. Sudden increases and certain seasonal changes in echinoderm larvæ, ostracods and salps will be discussed in a later report.

It is estimated that the temporary planktonic animals, consisting of medusæ, coral planulæ, the larvæ of polychætes, cirripedes, decapods, euphausiids, stomatopods, gastropods, lamellibranchs and echinoderms, and larval fish, form about 10–15 per cent of the whole plankton taken in the coarse silk net vertical hauls and coarse mesh oblique and stramin oblique hauls. Gastropod, lamellibranch and echinoderm larvæ (the last restricted to a very short period), decapod and euphausiid larvæ are the most important. Of the last two, the decapod larvæ were usually more abundant, although euphausiid larvæ occurred in large numbers at times. In the stramin net catches the decapod larvæ were easily the most abundant representatives of the temporary plankton, an interesting form occurring frequently being *Leptochela pugnax*. The rarity of coral planulæ is striking, and compared with northern waters there were few cirripede nauplii.

A comparison of these results from the Great Barrier Reef lagoon with those of the International Council for the Exploration of the Sea in northern European waters in 1910 and 1911, where a Nansen net of silk No. 3 was of exactly the same dimensions as the coarse silk net used for the above experiments, is of great interest. Also more recent catches off Plymouth are compared. It was found that the Barrier Reef zooplankton is as rich numerically when averaged over the year as that of the northern regions compared. The great seasonal changes in the latter show much larger increases and decreases in the individual months. Comparisons in volume show that the Barrier Reef samples have more volume but fewer animals, to be accounted for by the greater compactness of the northern plankton.

Temperature must be taken into account in these comparisons, and the much higher rate of metabolism probable in warmer waters; also that there is apparently no surplus plant life at any time as there is in colder seas after diatom outbursts. The hydrographical and weather conditions are such that the diatoms are continually in a state of suspension and do not sink. It seems probable that throughout the year the animal plankton population is the maximum that the plant crop can support and that there is a comparatively rich supply of plankton animals available as food. Is there enough for the huge number of animal eating corals? It would seem that there are fewer plankton-eating fishes than in northern waters, where clupeoids and mackerel prey to such an extent on the animal plankton, and that the bottom life in these regions is poor compared with that in northern waters. Thus more food is available for the plankton-eating invertebrates. The corals are night feeders and there is an enormous plankton life at night in this vicinity. The inference is that the planktonic life is sufficient to support the corals.

Science News a Century Ago

The Entomological Society

AT a meeting of the Entomological Society held on August 3, 1835, Mr. J. F. Stephens (1792–1852) being in the chair, "Various curious and remarkable insects were exhibited, amongst them the Indian leaf insect (*Phillium siccifolium*) in its different stages, from the collection of Mr. Saunders. A living capricorn beetle was exhibited by Mr. Desvignes, which had been reared in a piece of furniture nearly ten years old. Specimens of the vegetation wasp, horse tick, spider silk, etc., from the island of St. Domingo were exhibited by Mr. Hearne. The chairman also exhibited a specimen of the very rare and singular bee parasite, *Elenchus tenuicornis* Kirby, recently captured by himself, and made some observations on its peculiarities."

"The memoirs read consisted of a note upon the insects found in unrolling a mummy at Belfast, by Mr. Patterson, president of the Natural History Society of that city; an account of the *Poma Sodomitica*, or Dead Sea apples, a production respecting which travellers and botanists have been greatly at issue, but which has lately been ascertained to be a vegetable gall of a very large size, by Walter Elliot, Esq., by whom these productions were discovered growing in Palestine, and who has reared the insects which produce them". (*Athenaeum.*)

Experiments with the Lime Light

ON August 5, 1835, *The Times* gave an account of the experiments with the limelight made on the top of the Colosseum in London by Mr. Alexander Gordon. Gordon employed four jets of oxy-hydrogen gas impinging on a cylinder of lime and an arrangement of lenses which caused the light to pass out in a sheet or fan. "It is a very simple, though excellent invention, and appears capable of being applied to lighthouses and similar buildings with great efficacy. . . ."

Reappearance of Halley's Comet

NO astronomical event of 1835 was looked forward to with greater interest than the reappearance of Halley's comet, last seen in 1759. As early as 1817, its motion and perturbations since 1759 were proposed by the Turin Academy of Sciences as a subject for a prize, which was awarded to Baron Damoiseau. The Paris Academy of Sciences adjudged a similar reward to Pontécoulant in 1829, while Rosenberger's calculations won for him the Gold Medal of the Royal Astronomical Society. The comet was first seen on August 6, 1835, by the astronomers at the Jesuits' College at Rome as "a nearly circular misty object" and it was afterwards watched by astronomers in various countries. The error of Rosenberger's ephemeris was only seven minutes of arc, and the perihelion passage took place on November 16, five days after the predicted time. Owing to its southern declination, it was seen to greatest advantage at the Cape of Good Hope by Maclear and Sir John Herschel, who continued to observe it until May 5, 1836, when it finally ceased to be visible. Reviewing the calculations made regarding the comet, Grant said: "The fidelity with which it responded to the deductions of the geometer on the occasion of its last appearance forms one of the many magnificent triumphs which adorn the history of the Theory of Gravitation".

The British Association at Dublin

THE Dublin correspondent of *The Times*, writing on August 7, 1835, said: "A considerable number of distinguished literary visitors are already in this city, for the purpose of attending the meetings of the British Association, which commence on Monday. The *William Penn*, from Liverpool, with a great many more, is expected at Kingstown this evening. Many curiosities are looked for during this eventful week in Dublin; but Lord Brougham is expected as the 'great lion'. I am sure his Lordship will feel quite at home in Ireland". Writing again on August 9, the correspondent said: "Up to 5 o'clock yesterday evening the council of the Association was occupied with the admission of members. Mr. Thomas Moore, accompanied by Dr. Lardner, arrived in town yesterday. On Friday evening the *William Penn* reached Kingstown from Liverpool, freighted with scientific visitors amongst whom were Dr. Babbage and Sir John Ross. The same vessel is expected this evening with a similar cargo. There are several foreigners in town as delegates from various parts of the continent. Many are the 'lions' we have already, but alas! Lord Brougham is not to be amongst us, and the lovers of curiosities are mortified accordingly".

Societies and Academies

EDINBURGH

Royal Society, July 1. ALAN W. MOZLEY: The freshwater and terrestrial mollusca of Northern Asia: A critical and detailed study of sixty-seven species and sub-species of non-marine mollusca from Siberia, fifty being aquatic and seventeen terrestrial. They are of four categories: (i) those common to Europe and Asia; (ii) those that are circumboreal: (iii) those common to north-east Asia; and (iv) those endemic to Siberia. The various habitats are described. From the point of view of molluscan distribution, four faunal regions are recognised: (i) the great Siberian region; (ii) the Baikal region (this is rich but so peculiar and specialised that it falls outside the scope of the present paper); (iii) the far eastern region; and (iv) the Chuckchee-Kamchatka peninsula. S. M. K. HENDERSON: Ordovician submarine disturbances in the Girvan district. The Ardwell Beds, a series of greywackes of Lower Caradoc age in the Girvan district of Ayrshire, contain intraformational breccias and slip-bedding; grading, with accompanying minor current bedding, is common throughout. The disturbed bands rarely exceed three inches and show an eroded upper surface, especially clear in examples of slipping. In the case of breccias, submarine earthquakes loosened and broke up the sea floor sediment; resultant tunamis tore up and distributed the debris. Sediments of a more plastic nature slid down submarine slopes. A boulder bed has likewise been attributed to the slipping of sediment down a submarine slope. MARY G. CALDER: Further observations on the genus *Lyginorachis*, Kidston. Three new species of the fossil genus *Lyginorachis* are described, namely, *L. Waltoni*, *L. Brownii* and *L. trinervis*. The specimens are all from rocks of Calciferous Sandstone age in the west of Scotland, *L. Waltoni* being from Arran and *L. Brownii* and *L. trinervis* from the Kilpatrick Hills. Some additional notes are also made on *Lyginorachis taitiana*, from specimens in the Kidston Collection of Fossil Plant Slides. STEWART MACLAGAN and EDWARD DUNN: The experimental analysis of the growth of an insect-population. Experiments with the rice weevil (*C. oryzæ*) have shown that a population of these beetles offers a certain internal resistance to its own growth. This is effected through a decrease in the copulation frequency, fecundity and fertility of the adults, with increasing density; and an increase in larval mortality. The behaviour of the beetles is entirely irrational, the limitation of population growth being brought about by influences which are primarily thigmotropic. So precise is the relationship between the population density and the copulation frequency of the beetles that it can be described by the equation $Y = aX^{-b}$, where Y represents copulation frequency and X the population density (see also NATURE, Jan. 5, p. 33). T. M. MACROBERT: Some series and integrals involving associated Legendre functions, regarded as functions of their degrees. Legendre functions and products of Legendre functions in finite integrals and series are replaced by the corresponding Mehler-Dirichlet integrals; the resulting formulæ are then expressed as Dirichlet integrals, and the limits of these integrals give the values of infinite integrals and series.

PARIS

Academy of Sciences, June 17 (*C.R.*, 200, 2045–2128). AUGUSTE LUMIÈRE and MLLE. SUZANNE SONNERY: Variations in the leucocyte formula produced by intravenous injections of carbon. CHR. PAUC: The resolution of abstract equations by a method of iteration. FRÉDÉRIC ROGER: The relation between the tangential and metric properties of certain sub-ensembles of Jordan curves. JEAN FAVARD: The polynomials of Tchebicheff. D. MICHNEVITCH: Functional groups and their applications. GEORGES VRANCEANU: The unitary theory of fields and non-holonome hypersurfaces. PIERRE VERNOTTE: Sketch of a theory of reactivity. BENJAMIN DE JEKHOWSKY: The number of asteroids and their effective mass. FRANÇOIS LINK: The eclipses of the satellites of Jupiter. D. G. DERVICHIAN: Correction to the constant of Eotvos reducing it to two distinct values. JEAN URBANEK: Form and symmetry of the electromagnetic equations: the equivalence of energy and mass. EMILE SEVIN: The levels of the neutron. PIERRE MESNAGE: The molecular emission spectra of some metallic salts. The spectra produced by the high-frequency discharge without electrodes were studied in the cases of silver chloride, zinc chloride and nickel chloride. RENÉ BERNARD: Production of the Vegard-Kaplan bands by the electronic bombardment of a mixture of argon and nitrogen. The spectrum as a whole showed a striking analogy with that of the night sky, owing to the presence of the Vegard-Kaplan bands. CASIMIR JAUSSERAN: The action of aqueous solutions on latent photographic images of different ages. MME. IRÈNE CURIE, HANS VON HALBAN, JR. and PIERRE PREISWERK: The radioactive elements formed during the irradiation of thorium by neutrons. One of the elements produced is an isotope of radium, another is an isotope of protactinium. HENRI MULLER: Hydrofluoric acid. WILFRIED HELLER: The spontaneous formation of definitely arranged aggregates in sols containing non-spherical particles. JULES GUÉRON and MARCEL

PRETTRE: The complexity of the reaction between ozone and potassium iodide. When ozone acts on potassium iodide, two reactions occur simultaneously, one giving iodine, the other iodate. PIERRE CARRÉ and DAVID LIBERMANN: The alkyl- and aryl-sulphinic esters. RENÉ RAMBAUD: The action of sodium ethylate on the γ-halocrotonic esters. JEAN JUNG: The recrystallisation of the diorites and quartz diorites of the Manson (Puy-de-Dôme) plateau under the influence of granite contact metamorphism. STOYAN PAVLOVITCH: The amphibolites of the Zlatibor massif (western Serbia). GEORGES DENIZOT: The tectonic of the massif of Allauch, near Marseilles. GEORGES CORROY: The bases of the Jurassic link of Roqueforcade-Nans to the north-west of Sainte-Baume. GEORGES CLAUZADE: The bases of the link of Roussargue-Liquette, to the west of Sainte-Baume. PAUL DELEAU: The presence of the Lias at Djebel Nador (Department of Oran). JEAN DRESCH: The structure of the Haouz of Marrakech. J. LACOSTE and C. BOIS: Remarks concerning the first movements of the soil during earthquakes affecting some European regions. ADOLPHE LEPAPE and GEORGES COLANGE: The presence of water vapour and carbon dioxide in the air of the stratosphere. The proportions of moisture and carbon dioxide in the air of the stratosphere, altitude 9–16 kilometres, is unexpectedly high. The carbon dioxide is about double that found at the surface, and the moisture much higher than corresponds to the temperature. CAMILLE ARAMBOURG: Observations on some fossil fishes of the order Halecostomes and on the origin of the Clupeids. MARCEL ABELOOS: The larval diapause and eclosion in the Coleoptera *Timarcha tenebricosa*. JEAN GIAJA and STEFAN GELINEO: The resistance of some homeotherms to low temperatures. Various animals and birds were submitted to temperatures ranging from − 35° C. to − 160° C., for short periods without injury. A dog after remaining in a chamber for five hours at − 160° C. was uninjured. HENRI BIERRY and BERNARD GOUZON: The fluorescence spectra of hepatoflavin before and after irradiation. ETIENNE WOLFF and ALBERT GINGLINGER: The experimental production of intermediate sex forms by the injection of folliculin in the embryo of the fowl. In the embryo of the fowl intersexuality can be regularly obtained by injecting genetically male individuals with folliculin, on condition that the injections be made before the seventh day and the dose about 100 international units. VICTOR PLOUVIER: Contribution to research on amygdonitrileglucoside and amygdaloside in plants. YERVANTE MANOUELIAN: Experimental syphilis. Lymphatic ganglia. Minute forms of *Spirochæta pallida*, syphilitic spirochætogen. LEDOUX-LEBARD, LONG and SAGET: Radioscopic examination in a lighted room.

MELBOURNE

Royal Society of Victoria, May 9. LEO STACH: Victorian Tertiary Catenicellidæ (Bryozoa), (3). This paper concludes a study of the systematics of the Tertiary Catenicellidæ, with a revision of members of the sub-families Catenicellinæ and Ditaxiporinæ. Notes on Scuticellinid gonœcia, the species incorrectly relegated to Catenicellidæ, and extra-Australian Tertiary species, are appended. A new genus, *Chelidozoum*, of the family Savignyellidæ is erected for *Claviporella vespertilio*, Macgillivray.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 235–299, May 15). H. C. SHERMAN and H. L. CAMPBELL: Rate of growth and length of life. Rats of the same heredity, initially in good health, living in the same environment and subsisting on one or other of two normal diets, both of which were adequate to maintain growth and health although one was better balanced quantitatively, show different rates of growth, those on the better diet growing faster. Growth rate and length of life, however, vary independently of one another. CHARLES E. DECKER: The graptolites of the Simpson group of Oklahoma. VIRGINIA H. RHOADES: The location of a gene for disease resistance in maize. Plants susceptible to physiological form 3 of *Puccinia Sorghi* were pollinated with material from a plant, homogeneous for the dominant factor for resistance, which had been irradiated with X-rays. Irradiation produces a chromosomal deficiency, and in susceptible offspring, the deficiency appeared in the short arm of the tenth and shortest chromosome of the haploid complement. Breeding experiments confirmed this finding. FRANK H. CLARK: Linkage relations in 'Zavadskaia shaker' in the house mouse (*Mus musculus*). This character is distinct from and is not linked with the characters 'ordinary shaker' and 'waltzing'. Linkage tests suggest that it is located in chromosome 14; and possibly the gene for hydrocephalus lies in the same chromosome. DONALD L. WEBB: Generation of any n-valued logic by one binary operation. W. E. SEWELL: Generalised derivatives and approximation. MARSTON MORSE and GEORGE B. VAN SCHAACK: Abstract critical sets. CHARLES N. MOORE: On convergence factors for series summable by Nörlund means. EDWARD V. HUNTINGTON: Effective equality and effective implication in formal logic. S. LEFSCHETZ: A theorem on extremals (1). ALONZO CHURCH: A proof of freedom from contradiction. JENNY E. ROSENTHAL: Intensities of vibration rotation bands. A theoretical discussion in which an exact expression for the probability of any transition $v' \leftarrow v''$ is derived for the case of a Morse potential function between the nuclei. It gives results in good agreement with experimental values for HCl. G. H. PARKER: What are the resting and the active states of chromatophores? The chromatophore systems of different animals are very differently organised so far as nerves are concerned, but all appear to be subject to neurohumoral control. Experiments on *Fundulus* in which bands across the tail were completely denervated by section of the nerves, showed that the melanophores of these bands were still active. It is concluded that pigment immobility in a melanophore defines the resting state. Brownian movement is greatly reduced in such a state, suggesting that the active and resting phases are characterised by the protoplasm of the melanophore being in the sol and gel states respectively. J. VAN OVERBEEK: The growth hormone and the dwarf type of growth in corn. The dwarf type *nana* differs from the normal race by a single gene. Coleoptiles are equal in length, but the mesocotyl of *nana* is shorter than the normal, due to decreased extension. Less growth substance (auxin) is given off by *nana* than normal corn, and less growth occurs for a given amount of auxin. It is concluded that more auxin is destroyed in *nana*, due to a change in oxidation-reduction properties, thus causing inhibition of growth.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, August 4

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J. Edwards: "Seashore Life".*

WORLD FEDERATION OF EDUCATION ASSOCIATIONS, August 10–17. Conference to be held in Oxford.

Official Publications Received

Great Britain and Ireland

The Institution of Gas Engineers Publication No. 105: Education Regulations, 1934 Revision: Regulations for the Education and Certification of those engaged in the Technical Work of the Gas Industry and for the Award of Certificates in Gas Works Practice, Gas Supply Practice and Gas Fitting of the City and Guilds of London Institute. Pp 84 Publication No. 106: 72nd Annual General Meeting, London, 4th to 7th June 1935; Official Programme. Pp. 16. Publication No 107: 72nd Annual Report and Accounts of the Council of the Institution of Gas Engineers to be presented at the 72nd Annual General Meeting to be held at the Institution of Civil Engineers, on the 4th, 5th and 6th June 1935. Pp. 40. Publication No. 108: Presidential Address (72nd Annual General Meeting) by Charles Valon Bennett. Pp. 16. Publication No. 109: National Policies governing the Testing of Gas Appliances. By Stephen Lacey and C. A. Masterman. Pp. 44. Publication 110: Problems and Answers in the Reconstruction of Manufacturing and Distribution Plant, Nottingham. By George Dixon. Pp. 80+3 plates. Publication No. 111: The Gas Account. By W. B. McLusky. Pp. 44. Publication No. 112: Development of Gas Sales; Policy and Performance. By Samuel B. Chandler. Pp. 48+6 plates. Publication No. 113: Waste Heat Recovery from Retort Settings. By Major W. Gregson. Pp. 40+1 plate. Publication No. 114: The Preparation, Marketing and Utilization of Coke. By W. L Boon. Pp 88+2 plates. (London: Institution of Gas Engineers.)

Observations of Stellar Parallax, Vol. 2. From Photographs taken and measured at the Royal Observatory, Greenwich, under the direction of Sir Frank Dyson. Pp 158. (London: H M. Stationery Office.) 12*s*. net.

Observations made at the Royal Observatory, Greenwich, in the Year 1933, in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson and Dr. H. Spencer Jones. Pp. viii+A74+B4+Cx+C52+D66+E46+22+4 plates: (London: H.M. Stationery Office.) 22*s*. 6*d*. net.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 33. On the Biological Condition of Relaid Oysters, 1935. By Dr. J. H. Orton. Pp. 533–540. (Dublin: Hodges, Figgis and Co., London: Williams and Norgate, Ltd) 6*d*.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1934. Pp. 312+9 plates. (Bristol: The University.)

Apples and Pears: Varieties and Cultivation in 1934. Report of the Conference held by the Royal Horticultural Society at the Crystal Palace, Sept. 19–21, 1934. Edited by F. J. Chittenden. Pp. iv+216+28 plates. (London: Royal Horticultural Society.) 7*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 25: Reports of the Irish Radium Committee for the Year 1934, including Reports by Oliver Chance, Dr. W G. Harvey, Oswald J. Murphy. Pp. 231–242. 1*s*. Vol. 21 (N.S.), No. 26. Note on the Effect of Storage on the Colour and on the Free Fatty Acid Content of a Commercial Sample of Veterinary Cod-Liver Oil. By B. J. Sheehy Pp. 243–245. 6*d*. (Dublin: Hodges, Figgis and Co., London: Williams and Norgate, Ltd.)

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1935. Pp. 16+4 plates. (Kirkhill: Hannah Dairy Research Institute.)

The Medical Research Council: What is it and how it Works. By Norah Dacre Fox. Pp. 12. (London: London and Provincial Anti-Vivisection Society.)

Technical College Buildings: their Planning and Equipment. A Report by a Joint Committee of the Association of Technical Institutions and the Association of Principals of Technical Institutions with Representatives of the Royal Institute of British Architects and the Institute of Builders and a Member of the Staff of the Board of Education. Pp. xii+144+20 plates. (London: Association of Technical Institutions and the Association of Principals of Technical Institutions.) 3*s*.

Other Countries

Pasteur Institute of India, Kasauli. The thirty-third Annual Report of the Director of the Institute for the Year 1933, Part 2. Pp. 44. (Kasauli: Pasteur Institute of India.)

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PHYSICS Dept

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3432 SATURDAY, AUGUST 10, 1935 Vol. 136

The Future of British Agriculture

AT a time like the present, when radical changes are taking place or being contemplated in our national economy, when countries like Great Britain, Holland and Denmark are abandoning the policy of Free Trade and venturing on the thorny paths of Protection and national self-sufficiency, efforts to discern the future acquire an interest and importance that far outweigh the vaticinations of those who don the prophet's mantle in more settled and humdrum times. History, we know, is replete with the misjudgments and miscalculations of statesmen and politicians who, besides having to deal with the incalculable in human nature, have also been handicapped by lack of scientific training and outlook; and the question is now frequently asked whether men trained in the methods and content of science could not do better? So far, they have seldom been called upon to act, or even to advise, in the affairs of State; and it is not certain that, had they been asked, they would have been more successful than their contemporary statesmen, trained in the law, the humanities or in business. Are the views of scientifically trained men on political, economic, social, religious and philosophical questions more far-sighted, more reasoned and less biased by traditional beliefs and emotional prejudices than those of others?

We believe that a general vote on this question would result in a decided 'No': and the main reasons for the answer would be that the scientific mind, like the artistic, generally runs in grooves, and the methods that are applied so fruitfully in the positive sciences are either not applied, or if used are misapplied, in those spheres which to a large and regrettable extent are still dominated by instinct and desire rather than by reason and the public good. Although the doctrine that mental ability acquired in one sphere is not transferable to another unless the subject matter is correlated, seems to apply here, a case can be made out that scientific habits of mind, such as initial doubt, careful testing of fundamental assumptions and evaluation of evidence, do come within the category of transferable qualities. If this is so, it affords an additional reason why those engaged in scientific pursuits should seek to pull their weight in the social boat by using their talents in trying to solve some of the pressing social and economic questions that now await solution.

Prediction, based upon generalised knowledge of natural facts, is one of the major, and perhaps the most useful of the functions of science: we know how well it succeeds in the strictly mathematical sciences and in certain applied sciences like astronomy and engineering, but in agriculture, which is a congeries of applied sciences still largely dominated by tradition and empiricism, prediction is far more difficult; there are so many variables; the weather and the human factor between them upset many a calculation. Some measure of sympathy must therefore be extended to Sir John Russell, who, in his recent discourse at the Royal Institution on the future of British agriculture, set himself a very difficult task. Many eminent persons, he remarked, had lost their well-earned reputations by dabbling in the future, but in these critical times, one had to take risks; and the safer method was to base one's predictions on present trends and movements.

Among the unchanging elements in our agricultural economy, Sir John Russell mentioned the present regional distribution of crops, which is determined largely by climate and soil; it is,

however, an interesting fact that all our crops, excepting sugar-beet, hops and lucerne, are grown in every county, and it seems to us quite possible that efficiency in production and distribution might be increased by introducing some measure of rationalisation. According to free-trade principles, each country should grow what it is best fitted to grow, and exchange its excess for foreign products which it wants. Might not the same principle be applied to regions within a country? And is it not time to contemplate the subdivision of the country into regions that would take the place of the counties, many of which are very small and some minute, and in this way save expenditure on administration? We may yet live to see established a modern form of the old Anglo-Saxon heptarchy.

The sturdy, independent and strongly individualistic character of the English farmer will, Sir John suggested, remain as a bulwark against collectivist tendencies in the population, and that is to the good, because State supervision failed during the late War: it failed in France in the Revolution, and it is proving a failure in Russia now. Further, the English countryman's attachment to animals (however fond he may be of killing them!) will ensure that the production of animals and milk will continue to form the major part of his occupation; he is also likely to retain his love of craftsmanship and his dislike of mass production methods. Thanks to the development of agricultural education, there is arising a generation of farmers who are keener, more alert and more anxious to make the best of their farms than were their predecessors.

Implied in Sir John Russell's prognostications is the improbability of any really fundamental changes taking place in our political and economic structure. Our present individual farming, he holds, will persist, and continue to be of the small capitalist type that now occupies about one half of our farm-holdings with an area varying from 100 to 300 acres. There is, however, a prominent school of agricultural thought, of which Mr. C. S. Orwin, of the University of Oxford, is an able exponent, which believes that nationalisation of the land will follow as a direct consequence of our present parlous agricultural conditions. The old partnership relations of landlord and tenant have disappeared; the landlord has lost most of his capital and can no longer undertake the duties which that partnership imposed upon him. The land is crying out for fresh capital—for drainage, water supplies, farm equipment and housing—and if the changes which this school sees coming are brought about, namely, an increase in family-farms on one hand, and in large-scale, mechanised and specialised farms on the other, the call for new capital will be greater than ever. As an economic necessity, the State must take over the land, provide the necessary capital, but not necessarily control the farming practice.

It is not always realised that the vast majority of the world's farming is done by the peasant class—small men with little or no capital, whose standard of living is low compared with that of industrial workers, who are gluttons for work, and to whom agriculture is a mode of life rather than a money-making occupation. Although this type of farming cannot as a rule compare in economy and efficiency with the large-scale mechanised type, nevertheless it is encouraged by practically all Governments, because it represents an element of stability in the State: family-farmers are self-supporting in times of depression and they constitute a reserve of man-power in time of war. Even highly industrialised nations like Great Britain have been constrained to encourage this type, though not always with success. In this connexion, Sir John Russell points out that the main difficulties are concerned with marketing and leadership, and he does not believe that we should succeed in establishing co-operative colonies of smallholders on the highly successful lines of Denmark; he envisages rather a type of land settlement, self-contained and self-supporting, in which living, not selling, is the leitmotiv, each unit producing what it can and bartering its excess for commodities it does not produce. Some experiments of this kind are being made in England; they have been successful in French Canada, in other parts of the British Empire, and in the United States, but in nearly every case the settlers have been drawn together and united by a spiritual bond, such as the Church.

The factory type of farming, which is based on mechanisation of agricultural operations and specialisation in the growing of only one or two crops, is obviously the more economical in man and horse labour, but is not of such general application. Sir John Russell stated that the ordinary system of English farming requires 25–30 permanent employees per square mile, whereas on a highly mechanised farm in Saskatchewan one man per square mile suffices. The case for the development of factory farms and of

small holdings has been ably expounded by Mr. C. S. Orwin in his book on "The Future of Farming" (Oxford University Press, 1930), but his conclusions appear to be in direct opposition to Sir John Russell's prediction that the medium-sized farm owned by the small capitalist will continue to prevail in Great Britain.

If it cannot be admitted that British agriculture has grown and developed continuously from very early times, progress was catalysed by the coming of the industrial era and the fear of starvation during the Napoleonic wars. The growing of turnips, clover and rotation grasses, which did not become general until more than a hundred years after the idea had been introduced from Flanders; the improvements in livestock due to Bakewell, the brothers Colling, Thomas Bates and others; and later the use of artificial fertilisers and the breeding of new varieties and strains of economic plants, have all contributed their quotas to the great increases in production that were rendered necessary by tremendous growth in population. As in industry, the problem of production seems very largely to have been solved; the most urgent problems now are those of distribution and quality of product.

In Great Britain, however, the problem of increased production is still with us, for owing to our greatly reduced income from the export of goods and services and investments overseas, not to mention possible international complications, expert opinion is now generally agreed that we must grow more food at home. Sir John Russell agrees that our present output of 36–40 per cent of the nation's food supply is too low, and he asks for an impartial inquiry to be conducted by technical and business experts, and representatives of the Ministry of Agriculture, the Foreign, Colonial and Dominions Offices, who would advise where the line should be drawn. A question embodying this timely suggestion was asked in the House of Commons on July 15, when the Minister of Agriculture replied that it was not acceptable, but the Government was fully alive to the question of domestic production of food in relation both to the interests of agriculture and to the general economy of the country. It would appear that the Prime Minister and the Cabinet are not enamoured of deliberate long-term planning; their agricultural quiver seems to be fully charged with the intricate and delicate problems associated with the working of the various marketing boards, which were launched with the entirely praiseworthy object of securing an economic return to the producer. In Sir John Russell's view, the ordered development of British agriculture involves deciding how much should be produced at home; and he favours the contract system, with obligations on both sides, including the social obligation of paying a living wage to the workers. That system works well for milk, sugar-beet and bacon, but it is not applicable to produce like beef, mutton, potatoes, eggs, which are handled by a multitude of small distributors. The problem of distribution, it is generally conceded, is of outstanding importance, and no Government that does not tackle it resolutely and impartially is worthy of our support.

The history of British agriculture shows that although men of enlightenment have seldom been lacking, progress has usually been extremely slow, owing to the crusted conservatism of the farming population. In the last hundred years, science has done wonders in giving the farmer the means to increase production, but although he has used them to some extent, the potentialities, especially of fertilisers and of scientific breeding, still remain very great. In the past, the greatest spur to progress has always been economic necessity, and as this is now again in the ascendant, it seems probable that, at any rate in the near future, changes in our economic system generally are likely to play a greater part than the application of new scientific discoveries. When we reflect that about one quarter of our population is living to-day on or under the border-line of poverty, that the average income of 75 per cent of our insured workers is £3 a week or less, and that about 70 per cent of those who died in 1933–34 left no more than £100, or less, we cannot be surprised at the economic unrest that obtains in so many quarters. Until some solution or amelioration of the problem of the existence of poverty amidst plenty is forthcoming, substantial national progress seems out of the question.

The Chancellor of the Exchequer may derive satisfaction from the statement that "we" have recovered 80 per cent of our prosperity, and that "we meet in an atmosphere of such happiness and contentment as has not been seen since the War" (as he told the bankers in a recent post-prandial speech), but such assertions do not help the cause of social peace and development; rather do they, by substituting illusion and self-satisfaction for ascertainable fact and self-suppression, reflect an attitude of mind which is the negation of the realistic spirit of all true science.

The Oldest European Civilisation

The Palace of Minos:
a Comparative Account of the Successive Stages of the Early Cretan Civilization as illustrated by the Discoveries of Knossos. By Sir Arthur Evans. Vol. 4, Part 1: Emergence of Outer Western Enceinte, with New Illustrations, Artistic and Religious, of the Middle Minoan Phase; Chryselephantine 'Lady of Sports', 'Snake Room' and Full Story of the Cult; Late Minoan Ceramic Evolution and 'Palace Style'. Pp. xxxv+378+14 plates. Vol. 4, Part 2: 'Camp-Stool' Fresco—Long-robed Priests and Beneficent Genii; Chryselephantine Boy-God and Ritual Hair-Offering; Intaglio Types, M.M.III–L.M.II; Late Hoards of Sealings; Deposits of Inscribed Tablets and the Palace Stores; Linear Script B and its Mainland Extension; Closing Palatial Phase—'Room of Throne' and Final Catastrophe; with Epilogue on the Discovery of 'Ring of Minos' and 'Temple Tomb'. Pp. xvi+379–1018+22 plates. (London: Macmillan and Co., Ltd., 1935.) 2 parts, £9 9*s*. 0*d*. net.

THE fourth volume, in two parts, of "The Palace of Minos" completes what is the most remarkable account of an archæological site ever published, and it appears just forty years after Sir Arthur Evans began his first exploration at Knossos. The whole work, to use the author's own words, "has some title to be regarded as an Encyclopaedia of Minoan cultural features, of its Art, and of its Religion". These two parts run to 1,069 pages, with 966 figures in the text and 36 plates, and from this comprehensive material a reviewer can only select for comment some of the more remarkable matters here brought to light as illustrative of Minoan religion, art and civilisation.

We begin with the most recent additions to our knowledge of Minoan religion. In a private house adjoining the palace, there was found stored in a large jar a collection of objects belonging to a domestic snake cult. These articles included 'snake-tubes', large cylindrical vessels up which the snakes could climb to drink from little cups attached to the sides of the tubes, and a tripod 'snake table', the upper surface of which is divided into four separate compartments and has in the centre a base for a bowl to contain food for four snakes. Sir Arthur cites numerous parallels from other ages and regions of similar cults of domestic snakes (p. 138 ff.). The ring-snake, *Tropidonotus natrix*, still common on the site of Knossos, is apparently the species which was the special object of Minoan veneration and affection. Besides this, another snake is thought to have had influence of a different kind, its skin supplying a pattern, the 'wave and dot' motive, which is common in Minoan art. This is the cat-snake, *Tarbophis vivax*, which has markings rather like those of the adder. The author traces the spread of this pattern west to Etruria, where the snake was likewise an object of veneration and fear (p. 178 ff.). Like much else in Greek religion, the snake cults associated with Athena, Asklepios, dead heroes and ancestors had their Minoan precursors.

The custom familiar from classical Greece of the ceremonial cutting off of childhood's locks at puberty is another religious usage that is shown to have had a Minoan origin (p. 475 ff.). The exquisite ivory figurine of a boy, now illustrated for the first time, has his hair shorn off over the whole crown and is thought to have worn a skull-cap of thin gold upon his pate. This has led Sir Arthur to revise his view about some plaited locks carved in steatite found in a domestic sanctuary, and he now regards them as simply votive, comparing them with a Thessalian monument representing locks of votive hair.

In the sphere of art, this volume presents us with accounts and illustrations of some of the most admirable works of the Minoans. The ivory figure of the tonsured boy, already mentioned, is one of these; and it is interesting to be able to compare him with the other ivory 'boy-god', discussed by the author in a former volume, but here illustrated anew (p. 468 ff.). Both these little statuettes, typically Minoan as they are, surprise and delight by their astonishing realism. It is because the Minoan had little of the liking for such metrical formalism as appealed to the early Greek artist that these Cretan works of art often seem more akin to the fourth century B.C. than to the age of archaic art. What is perhaps the finest Cretan masterpiece yet discovered—finer even than the famous Boston ivory goddess—appears on the frontispiece of the first of these two volumes. It is the gold and ivory figure of a girl dressed for the Minoan bull-ring. It is now in the Toronto Museum. Sir Arthur Evans calls her "our Lady of Sports", regarding her as the Minoan goddess herself in the dress of one of her protégés, the taureadors of those days. Another work of a very high order is a gold pendant in the form of two bees or hornets symmetrically grouped with a ball and a granulated disc between

them (p. 75). This ornament, dating back to about the twenty-third century B.C., is one of the finest extant examples of the goldsmith's art. For the rest, many charming art miniatures are illustrated among the engraved stones, rings and sealings which are fully discussed in these volumes.

It is, however, the evidence for the high degree of Minoan civilisation that always fills the present generation with admiration and wonder. Earlier volumes have familiarised us with the efficiency of Knossian sanitation, and here we have something more about the well-designed drain-pipes and the carefully made refuse-pits for dumping rubbish. We glean in passing that Minoans may have held cattle-shows, that they were meticulous in their business methods, that the palace magazines could store as much as 16,800 gallons of oil. They used camp-stools, their women were lavish in the employment of 'make-up', and as early as the fifteenth century before our era they were wearing gloves. Towards the end of the volume, there is a full account of Minoan script, for which the Oxford University Press has now a fount. Numerals can be read, the gist of some of the writings can be grasped; but until a bilingual text turns up we cannot read the language that Minos spoke.

How did this great civilisation come to an end? It has usually been held that a piratical raid, perhaps of 'Achæans' from the Greek mainland, destroyed the Cretan palaces with fire and sword. Sir Arthur Evans puts forward the suggestion that an earthquake, more serious than many that had occurred before on this shock-ridden site, shattered the palace, which was partly gutted, and that the Minoan dynasty removed the seat of Government to some healthier spot. There was, at any rate, a persistent tradition in classical times that Minos met his end in Sicily (p. 959 ff.).

The oldest civilisation in Europe is set before us in a strangely vivid fashion by the author's discoveries. This work is literally 'epoch-making', because Sir Arthur has supplied the epochs for European prehistory; but he has done more, because he has made the Minoan Cretans live for us. He has pictured a race bound to sacerdotalism and haunted by the supernatural, a people whose art like their culture was sometimes superficial. Yet they prepared the way for the civilisation of the Greeks and consequently for our own. We can look back and say that poetry, history, philosophy and science might not have arisen in the world but for those early and successful attempts of the Minoans to build an ordered and civilised society.

C. T. S.

Vibration in Engineering

(1) Practical Solution of Torsional Vibration Problems:
with Examples from Marine, Electrical and Automobile Engineering Practice. By W. Ker Wilson. Pp. xviii+438. (London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

(2) Torsional Vibration:
Elementary Theory and Design Calculations. By W. A. Tuplin. Pp. xviii+320. (London: Chapman and Hall, Ltd., 1934.) 21*s*. net.

(3) The Theory of Vibrations for Engineers:
an Intermediate Course. By E. B. Cole. Pp. x+263. (London: Crosby Lockwood and Son, Ltd, 1935.) 15*s*. net.

THE theory of vibrations has in recent years become of dominating importance in engineering. It is well known, for example, that vibrations in heavy machinery may be of a destructive nature, causing failures in the machines themselves and having damaging effects upon surrounding structures. The growing importance of the subject is leading to a considerable output of research but, although a number of books have been published in other countries, especially Germany, there has been until now no reasonably complete exposition in English of the more recent work on the torsional vibrations of shafts.

(1 and 2) Mr. Ker Wilson and Mr. Tuplin have each devoted a complete book to this important division of the subject of vibrations, and have discussed the applications of the theory to the design of multi-cylinder engines. Mr. Wilson, in a book of more than 400 pages, has been able to give a very thorough account, with numerous practical examples, many drawn from marine engine design. He also devotes a great deal of space to the theory and design of damping devices and to instruments for the measurement of vibration amplitudes. His work should prove of great service to many practising engineers.

Mr. Tuplin's treatise includes very full details of practical methods as well as much general theory. His book is shorter than Mr. Wilson's but, in the space at his disposal, he has included a surprisingly large amount of

material without giving any impression of crowding or undue abbreviation. Except that he does not discuss measuring devices, he deals with nearly all the subject matter of the larger book and he includes a number of fully worked practical examples. Many of his methods differ from Mr. Wilson's, and the two books should be regarded as mutually complementary rather than as alternatives.

(3) Mr. Cole's book is of a different nature, being an introductory textbook on the general theory of those parts of the subject of vibrations that are important to engineers. The theories of free vibrations, with and without damping, and of forced vibrations are first dealt with. Engine vibrations, the elimination of vibration, the transverse vibrations of beams, and the whirling of shafts are then briefly discussed. The exposition is throughout very clear and is helped by a large number of excellent figures. Examples for practice are added at the ends of the principal sections, the answers being given. All engineering students with any mathematical ability would profit by using this book as a supplement to the chapters on vibrations in their textbooks of strength of materials and theory of machines, and many mature engineers might find it of value as an introduction to more specialised treatises and original papers.

The Reptiles of China

The Reptiles of China:
Turtles, Crocodilians, Snakes, Lizards. By Clifford H. Pope. (Central Asiatic Expeditions: Natural History of Central Asia, Vol. 10.) Pp. lii+604 +27 plates. (New York: American Museum of Natural History and G. P. Putnam's Sons; London: G. P. Putnam's Sons, 1935.) 10 dollars.

MR. POPE'S "Reptiles of China" is the outcome of some fourteen years of continuous study. Four of these were spent in the field collecting and observing, the remainder in a more detailed study of his material in New York, and a comparison of it with the collections already existing in the other great museums of the world. No complete survey of this large area has been attempted before, and herpetologists will be grateful to Mr. Pope for having collected, examined and arranged the mass of material and literature relating to the subject which is now available.

The area dealt with is China south of a line connecting the northern extremity of the Gulf of Liaotung with the northernmost point of Kansu Province. This, although the author does not say so, is, roughly speaking, China south of the Great Wall, together with the eastern part of Tibet; the Island of Hainan is included but not Formosa. The bulk of the volume, pp. 19–453, is given up to the account of the Chelonians (22 species), the Crocodilians (1 species) and Snakes (130 species and subspecies); while the Lizards (65 species, pp. 457–487) are condensed into an annotated check list, with keys for their identification.

The descriptions, although short, are generally sufficient for their purpose. For the first time in any large textbook, we have details of the sexual variation in snakes and of their penial characters. That the latter have considerable specific value cannot now be doubted, although their full taxonomic importance can only be assessed when we have a wider knowledge of them. Habits also, in so far as they are known, are fully recorded. The field-naturalist will welcome these, but to the museum worker they have also a value, although at present he is inclined to ignore them. The mental 'make-up' of reptiles, as shown by their mode of life, has scarcely yet been studied, but it is evident that certain habits are confined to certain groups and, in their way, are as distinctive of the group as morphological characters. When they can be properly interpreted and correlated, they will have a significance which the taxonomist cannot afford to ignore.

On the other hand, the descriptions as regards external morphological characters, particularly those relating to the generic diagnoses, appear sometimes too brief. This is a pity, for a work of this magnitude, although intended primarily as a means of identifying the species, would have been so much more valuable had it included also that general anatomy which forms the basis of our classification and upon which the identifications depend. Without a knowledge of the generic characters also, it will be difficult sometimes to place a species new to science, or one new to the country and not mentioned in the work.

The volume is well illustrated; most of the text figures are new. There is a map, and a list of localities where collections have been made; these are all properly fixed as regards their geographical positions, a very necessary procedure for a region that is so little known. The bibliography includes all the available literature up to 1934. Mr. Pope has spared no pains to make his work as complete as possible; he is to be heartily congratulated on the result.

M. A. S.

A Manual of the Principles of Meteorology
By R. Mountford Deeley. Pp. xi+285+4 plates. (London: Charles Griffin and Co., Ltd., 1935.) 15*s*. net.

THIS is not a manual so much as a criticism of the present science of meteorology. The author points out that the distribution of temperature in the lowest six miles or so of the atmosphere—the troposphere—does not fit the pressure distribution, the lowest pressures occurring in high latitudes where the air is coldest. Differences of pressure on the earth's surface must therefore be caused by differences of temperature at high levels in the stratosphere, which is relatively warm in high latitudes and over barometric depressions, and relatively cold in low latitudes and over anticyclones. His thesis is that this high-level heating is caused by corpuscular radiation from the sun; the main stream of corpuscles is directed by the earth's magnetism into two sub-polar rings which therefore form belts of low pressure, while local barometric depressions originate from stray streams of corpuscles.

The main support for this theory is found in a series of diagrams comparing the mean daily pressures and ranges of pressure over the North Atlantic with daily sunspot numbers, which show some general resemblances (and also many discrepancies), but the author also considers that variations of corpuscular radiation explain the great climatic changes of geological time.

The style is discursive and often obscure, while there are many small errors and some serious omissions. For example, there is only the barest reference to the Bjerknes theory of cyclones and no mention at all of the 'polar front' or of Simpson's well-known theory of the part played by variations of solar radiation in climatic changes. The get-up is good on the whole, but the isothermal maps are poor.

Leçons de zoologie: Annélides
Par Prof. M. Prenant. (Actualités scientifiques et industrielles, 196.) Pp. 95. (Paris: Hermann et Cie, 1935.) 16 francs.

THE author has selected his material judiciously so as to give the reader an account of the principal structural and biological features of annelids. Brief descriptions of *Polygordius* and of its trochosphere larva, of *Nereis* as a type of the Polychæta, and of the principal variations in parapodia and in a few other structural features precede the classification and the two pages devoted to the ecology of marine worms. A more summary consideration follows of the Oligochæta, Hirudinea, Myzostomida and Echiurida, the last giving the opportunity for observations on the determination of sex in *Bonellia*. The comparative account of the excretory organs and the chapters on regeneration and asexual reproduction, often with accompanying changes of form, for example, in *Heteronereis*, are of particular interest. The figure of a trochosphere of *Echiurus* showing a segmented mesoderm is incorrectly attributed to Baltzer, who stated that the mesoderm is unsegmented.

Problèmes actuels de l'astrophysique
Par Prof. L. Houllevigue. Pp. xii+268. (Paris: Armand Colin, 1935.) 14 francs.

IN this volume Prof. Houllevigue gives an interesting and chatty account of many of the points at which the astronomer of to-day is touching upon the palpably unknown. It is interesting to see not only the selection of problems made by the author but also the way in which these problems are envisaged by a Frenchman. To take one example of his special point of view, the chief emphasis in his account of recent and coming advances in telescopes is placed upon the Ritchey-Chrétien researches, whereas most people would deal with the 200-inch telescope now being constructed for California. Among the twenty-five subjects chosen, we may mention the Cepheids, the corona, solar radiation, Saturn's rings, celestial 'wanderers', the evolution and expansion of the universe, novæ, interstellar gas, in order to show the range covered by the book.

The treatment is simple and popular, astronomers of many countries are fairly represented in the appropriate sections and the book will be read with very considerable interest, even where the reader does not agree with the author's point of view.

Worlds in the Making
By R. Barnard Way. Pp. 136. (London: The Chatterbox Co., Ltd., 1934.) 3*s*. 6*d*. net.

THE evolution of planets from primordial matter through nebulæ, galaxies and stars is here described in simple language, accompanied by a general description of the universe as it is at present and of the various objects composing it, from electrons to spiral nebulæ. The development of our own earth up to its present physical state and into a possible future one is given in detail, forming the main theme of the second half of the book, which is well illustrated with numerous drawings and diagrams made by the author. Although obviously intended for young people, the presentation of the subject is not too childish to appeal to older readers who require a brief elementary survey of the origin of worlds in general and of our own in particular.

Intermediate Physics
By Dr. C. J. Smith. Second edition. Pp. xii+900. (London: Edward Arnold and Co., 1935.) 16*s*. net.

THE call for a second edition shows that Dr. Smith's book is well appreciated, and it is clear that a great amount of work has been done in its preparation. Amongst the additions and improvements may be noted the theory of dimensions in Part I, a remodelling of a great deal of Part II, an increase in the matter dealing with interference in Part III, a short section on supersonics in Part IV, and an entire rearrangement of Part V. Candidates in university scholarship examinations should now find all the material for answering the papers in physics, and the harder matter is carefully distinguished from that dealing with fundamentals, which latter is adequate for the needs of the intermediate or pass candidate, to whom the book can be highly recommended.

Phosphate in the Western Basin of the North Atlantic*

By H. R. Seiwell, Woods Hole Oceanographic Institution

SINCE various investigators have illustrated the dependence of marine plant growth on certain inorganic substances in the sea[1], a knowledge of the variation and mechanism of the phosphate distribution is significant in questions of marine fertility. Dissolved phosphate investigations have taken a place along with studies of other fundamental properties of sea-water, and lately these results are also being used as identifying properties for the purpose of tracing the origin and courses of water masses in the sea.

Phosphate observations considered here were obtained during the *Atlantis* cruises of 1931 to 1933 in the western basin of the North Atlantic[2]. The investigation of dissolved phosphate in this region is similar to that made in the South Atlantic within recent years by the *Discovery*[3] and the *Meteor*[4]; and in the northern North Atlantic by the *Meteor*[5].

In general, within the area of investigation, vertical distribution of phosphate in the upper part of the water column parallels temperature (and density) distribution; the homogeneous water overlying the principal thermocline being almost exhausted of phosphate. Principal differences in vertical distribution of phosphate are indicated by variation in thickness of the phosphate-poor surface layer, and the variation of depth and value of the maximum phosphate concentration. The maximum horizontal variation of phosphate occurs at mid-depths.

It is convenient to classify the vertical distribution of phosphate phosphorus into three types characterising different parts of the western North Atlantic basin.

1. Convergence type: characterises the region influenced by the principal American coastwise convergence[6] (extending from Florida to Nova Scotia). The phosphate-poor surface layer (0–5 mgm. P per m.^{3}) is not more than 100 metres thick; below this, phosphate increases to a maximum value of about 30 or more mgm. of P per cubic metre at depths of 300–500 metres and then decreases slightly in still deeper water; at 2,000 metres, phosphate content is usually just less than 30 mgm. P per cubic metre.

2. Central Atlantic type: characterises the northern half of the area, east of the American coastwise convergences. The phosphate-poor surface layer (0–5 mgm. P per m.^{3}) overlies the principal thermocline and is generally 300–400 metres thick; below this, phosphate content increases to a maximum value of about 30 (or more) mgm. P per cubic metre at depths of 800–1,000 metres, and then decreases slightly in still deeper water.

3. Tropical Atlantic type: characterises the southern part of the area; the phosphate-poor surface layer (0–5 mgm. P per m.^{3}) is about 100 metres, or less, in thickness, below which phosphate rapidly increases to a well-developed maximum value of 50–60 mgm. per cubic metre at intermediate depths of 600–800 metres, and then decreases in still deeper water; at 2,000 metres, phosphate content is generally in the vicinity of 30 mgm. P per cubic metre.

The vertical distribution of phosphate (Fig. 1) shows that the water column becomes progressively richer in its most stable part (the thermocline), so that considerable resistance is offered to enrichment of the surface layers of the open ocean by the usual agencies which bring about vertical circulation (winter chilling, wind stirring, etc.). It is this condition which has led us hitherto to assume that well-developed discontinuity layers, such as occur in the tropical Atlantic, effectively shut off a supply of phosphate from the rich mid-strata to the illuminated surface layers[7].

The phenomenon of turbulence which accompanies all movements of sea water may be a significant factor in transporting phosphate, and other dissolved nutrient substances, from the rich midstrata, up into the illuminated surface layers of the open ocean. Turbulence results from impulses given to the water mass; in the case of a horizontal current, there is an accompanying vertical displacement of water particles which brings about an exchange of properties between different strata. The magnitude of turbulence, or eddy motion, in the sea is expressed by the coefficient of eddy conductivity (having the dimensions of grams per centimetre per second) which appears to lie usually between 1 and 20 C.G.S. units[8].

To make use of the concept of turbulence for the purpose of calculating the amount of phosphate transported vertically from the depth of its maximum concentration up into the illuminated layer of the sea, the phosphate gradient and the average eddy coefficient characterising that part of the

* Contribution No. 77 from the Woods Hole Oceanographic Institution.

water column involved in the transport must be known. The magnitude of the transfer of phosphate by eddy conductivity may be calculated by the following equation:

$$N = \frac{A}{\rho}\frac{dP}{dz},$$

where N represents phosphate (grams) transported per second through a square centimetre of area; A, the coefficient of eddy conductivity (C.G.S. units); ρ, the density of the water; and dP/dz the average vertical variation of phosphate (grams per cubic centimetre per centimetre). The phosphate gradient can be measured with a fair degree of accuracy, but the average eddy coefficient must be approximated at the present time. The method and arguments used to determine the order of magnitude of eddy conductivity in the western North Atlantic have been previously discussed by me[2], and here it will suffice to state that in that part of the water column involved in the upward transport of phosphate (between depth of phosphate maxima and homogeneous layer) the average eddy coefficient was calculated to range from about 30 C.G.S. units, north of lat. 30° N., to 10 C.G.S. units or less, south of lat. 15° N.

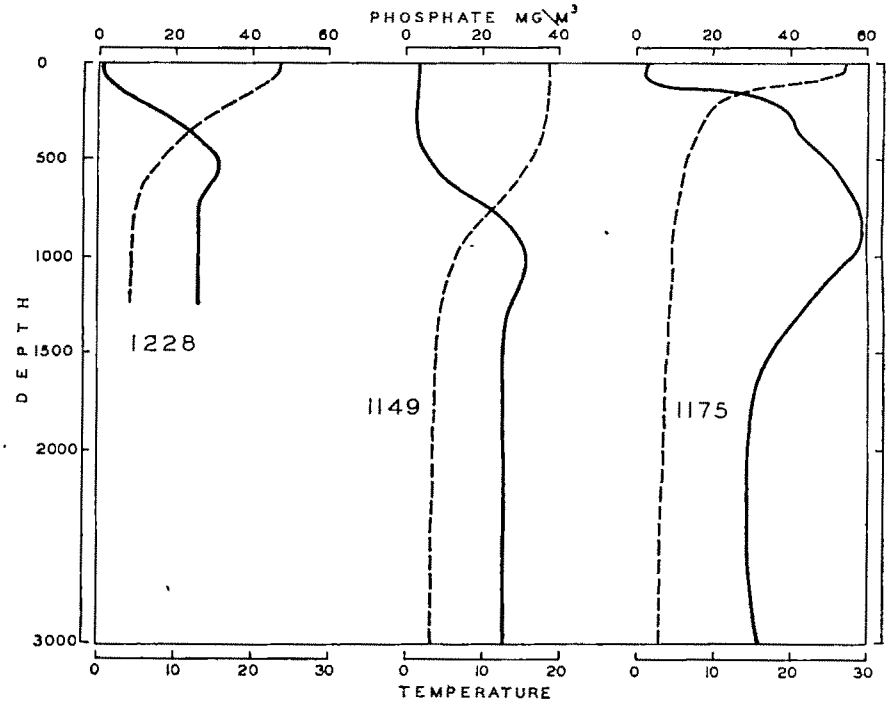

FIG. 1. Vertical distribution of phosphate (mgm. P per m³) and temperature at *Atlantis* stations 1228 (35° 37′ N., 73° 05′ W.), 1149 (32° 59′ N., 60° 16′ W.) and 1175 (6° 50′ N., 40° 25′ W.); February–April 1932.

The amount of phosphate transported annually from the phosphate-rich midstrata to the homogeneous water overlying the thermocline, as calculated, ranged from $3{\cdot}0 \times 10^{-4}$ gm. P per square centimetre of horizontal area in the extreme south to more than 6×10^{-4} gm. in the north central part of the area. Thus, in the southern half of the area the higher midstrata concentrations of phosphate (with correspondingly greater variations with depth, Fig. 1) are offset in their influence on the eddy transport of phosphate by decreased turbulence.

After phosphate has been transported into the water overlying the principal thermocline, it is available for phytoplanktonic consumption either by direct utilisation (if the thermocline is sufficiently close to the surface) or by stirring of the relatively homogeneous layer by winds, waves, etc. If this transported phosphate enriches the water over the thermocline uniformly, the increased concentration per unit volume may be calculated by dividing the amount of phosphate transported per unit area[8] by the thickness of the homogeneous layer.

According to our calculations, the annual phosphate enrichment of the homogeneous water, per cubic metre, decreases in a south–north direction from more than 60 mgm. P in the south to less than 20 mgm. in the north central part of the area. Hence, in the south a unit volume of homogeneous water receives about four times as much phosphate by eddy transfer as it does in the north, whereas in the south the total supply, per unit of surface area, to the water over the thermocline is only about one half as much as in the north. The discrepancy results from the lesser thickness of the water layer overlying the thermocline in the tropics; and the contrast indicates that, within the area, regional variations of chemical fertility cannot be estimated on the basis of unit volume measurements alone. Indeed, this analysis also suggests that, when comparing the fertility of other regions, a consideration only of the concentrations of nutrient substances per unit volume of water may lead to erroneous interpretation of conditions, particularly if the regions differ

in vertical distribution of their physical and chemical qualities.

On the basis of our recent results, it is tentatively concluded that, throughout the entire basin of the western North Atlantic, regardless of existing vertical density gradients, there is a significant eddy transfer of phosphate from the rich mid-strata to the impoverished surface layers. This, in general, is opposed to previous ideas that, in the open ocean, well-developed discontinuity layers restrict vertical transfers of dissolved nutrient substances from the rich underlying midstrata.

It is apparent that, in the open ocean, the consequence of the eddy transfer of nutrient substances to biological fertility will depend on the extent to which plant activity is confined above the principal thermocline; for, if photosynthetic activity should, for example, occur within the illuminated part of the thermocline of tropical waters, then there would be available for plant growth a supply of nutrient substances as great as occurs anywhere in the oceans. However, the vertical distribution of oxygen and phosphate in this region[2] suggest that, in general, the depth of plant activity is limited principally to the water overlying the thermocline, even in low latitudes where the latter extends well up into the illuminated part of the water column. This idea is, at least, not refuted by the few results of phytoplanktonic investigations in mid Atlantic.

That some factor other than light may limit the depth of photosynthesis seems probable; hydrographic conditions in the western North Atlantic suggest that temperature may bar access to tropical latitudes for plant species adjusted to low temperatures, and thus restrict phytoplankton to the warmer water over the thermocline. In mid latitudes the great thickness of the overlying warm water (Fig. 1) would, for lack of light, prevent a continuous phytoplanktonic distribution between surface strata in high latitudes and subsurface illuminated strata of similar temperature in the tropics. Phytoplanktonic communities in the tropics would thus tend to be limited to 'high temperature' species; and the lower and cooler parts of the photic layer would be left barren of plants unless some development of 'low temperature' organisms had taken place there independent of any direct connexion with similar 'low temperature' communities in high latitudes to the north or south.

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[2] H. R. Seiwell. The cycle of phosphorus in the western basin of the North Atlantic. I. Phosphate phosphorus. *Papers in Phys. Ocean. and Meteorol.*, 3, No. 4; 1935.

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[7] H. W. Harvey, *ibid.*, footnote 1. H. R. Seiwell, A consideration of some external factors governing the production of plankton in the sea, *J. Ecology*, 19, No. 1, 164–176; 1931.

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Scientific Research in China

The Academia Sinica

By V. K. Ting, Secretary-General, Academia Sinica, Nanking, China

'ACADEMIA SINICA' is the official designation for the Central Research Organisation established by the National Government in Nanking in 1928. According to its charter, it is the highest institution for scientific research in China. In the mind of its founders it is to be a sort of Academy of Sciences, Department of Scientific and Industrial Research, and Kaiser-Wilhelm-Gesellschaft combined. Unlike all the other institutions, it is independent of political control, for it does not come under any Ministry or Board, but is directly responsible to the National Government, which means the President of the Republic. It also functions as the highest national organisation for conferring honours upon individuals and institutions both at home and abroad that have distinguished themselves in science. For the purpose of directing and co-ordinating scientific activities in China, there is a council consisting of thirty members, selected from among the scientific workers of the country, and a certain number of ex-officio members who have also the right to elect candidates for the presidency of the Academia Sinica.

So far, however, its work as a group of closely connected and co-ordinated institutes for the purpose of carrying out original research has been more important than its other functions. As it

is constituted at present, it controls ten research institutes, including physics, chemistry, engineering, astronomy, meteorology, zoology and botany, psychology, geology, history and philology (including anthropology and archæology), and the social sciences. Thus the scope of research is extremely wide; for, on one hand, it includes such routine service as meteorology; on the other, it embraces the social sciences as well as history and philology, which are usually considered to belong to the 'humanities'. The following brief account will give some idea of the work being done in these institutions.

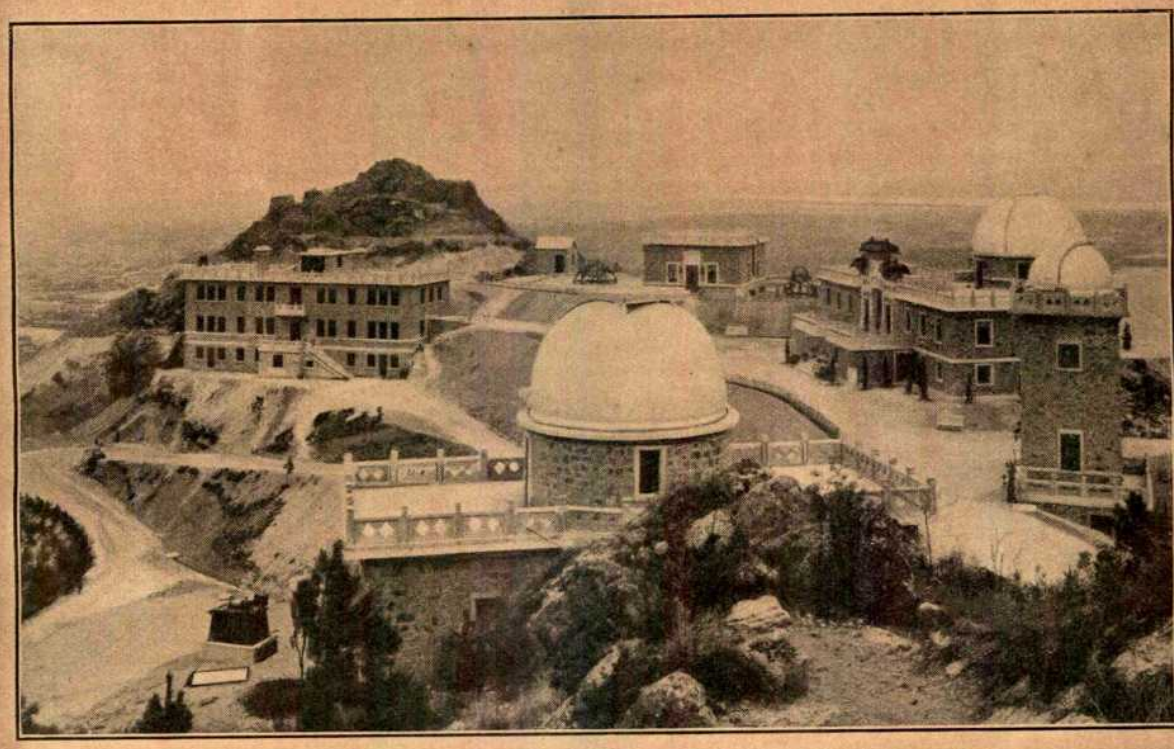

FIG. 1. Astronomical observatory of the Academia Sinica, on the Purple Mountain, near Nanking.

The Institutes of Astronomy and Meteorology are both located in Nanking. The former is built on one of the peaks of the Purple Mountain, 900 ft. above the plain just outside the east gate of Nanking (Fig. 1). It is one of the best equipped observatories in the Far East, having at its disposal one 600 mm. reflector, one 135 mm. meridian circle and one 200 mm. equatorial refractor with a 150 mm. astro-camera. In addition to compiling the almanac, supplying time service and determining geographical co-ordinates, the Institute of Astronomy carries out regular photometric and spectrophotometric studies of the sun, the planets and stars, makes observations of the variable stars, and studies solar activity with a Hale spectrohelioscope. The Institute of Meteorology is situated on another hill in the city. It is called Observatory Hill because an observatory was built there in the year 1341, and continued to exist down to the beginning of the seventeenth century. The present Institute possesses up-to-date equipment, and maintains in addition a seismological station. It has a radio-transmitting station of its own, and broadcasts its forecasts daily. It keeps in close touch with the provincial meteorological stations all over China, and maintains several branch stations of its own, including one at Kokonor and another at Lhasa. For the purpose of upper air investigation, weekly flights are made by arrangement with the Bureau of Aviation.

Three more institutes are located in Nanking: namely, those of geology, zoology and botany, and history and philology. The Institute of Geology has four sections: namely, stratigraphy and palæontology, petrology and mineralogy, economic and dynamic geology, and geophysics. Thus in scope it does not differ much from the National Geological Survey of China, which is an older institution under the Ministry of Industry, but more attention is paid to the theoretical side of geology. In co-operation with the National Geological Survey, it has also done considerable mapping, especially in the Yangtze Valley. Its publications, although less voluminous than those of the National Survey, have also gained international recognition. Its director, Dr. J. S. Lee, at the invitation of the Universities' China

Committee in London, has recently lectured on the geology of China before the Geological Society of London and in various universities of Great Britain.

The Institute of Zoology and Botany was originally the Metropolitan Museum of Natural History, which devoted itself exclusively to faunal and floral studies, especially of south and south-west China. With the organisation of a comprehensive National Museum under the joint auspices of the Academia Sinica and the Ministry of Education in 1934, it has been reorganised into the present Institute in order to avoid unnecessary duplication. At present the Institute concentrates its efforts on marine biology, especially fisheries, economic entomology and plant pathology.

Of all the institutes, that of history and philology is the best known outside China because of the important discoveries at Anyang in north Honan province, made by the Section of Archæology. For the first time, ancient Chinese history is being checked by carefully planned and executed excavations. The site was the capital of the Shang Dynasty (1500–1200 B.C.), and had been known since 1899, when bones inscribed with archaic characters were first brought to the antiquarian market. Since 1928, excavation work has been going on without interruption. An enormous number of inscribed bones and shells, bronze, pottery, stone implements and stone carvings belonging to different cultural periods have been uncovered, and buried palaces and mausoleums have been carefully unearthed and mapped. Some of the treasures are to be shown at the coming Exhibition of Chinese Art in London. International recognition came in the form of the award of the *prix de Stanilas Julien* by the French Academy. No less important although less spectacular are the works of the historical and the linguistic sections, both of which have issued a number of publications.

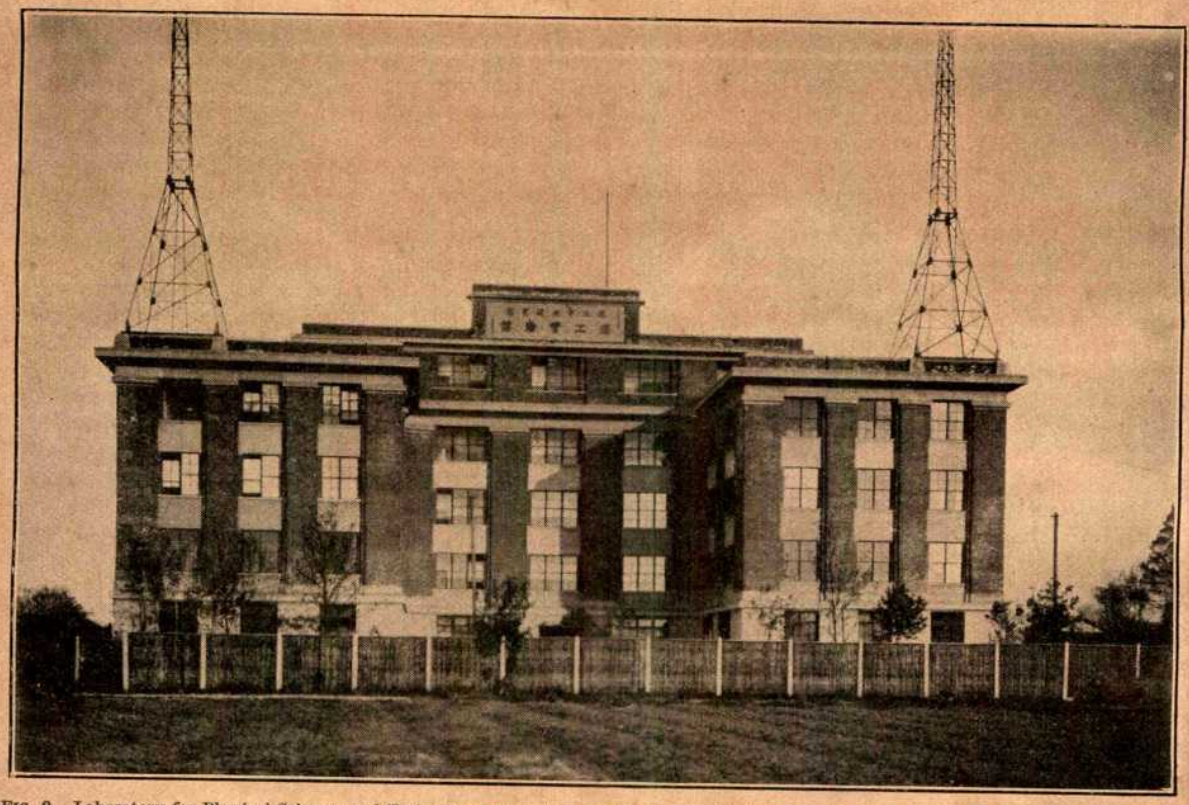

FIG. 2. Laboratory for Physical Sciences and Technology, Shanghai, housing the Institutes of Physics, Chemistry and Engineering of the Academia Sinica.

The Institute of Social Sciences was also founded in Nanking. It had four sections: those of law, economics, sociology and ethnology, the last of which has been the most productive. A number of monographic studies have been made on the primitive tribes in north-east and south-west China. In 1934 it was amalgamated with the Institute of Social Survey of the China Foundation for the Advancement of Education and Culture, and its head-quarters moved to Peiping. Thus reorganised, the new Institute devotes itself entirely to economic studies, and the old section of ethnology has been changed into that of anthropology and put under the Institute of History and Philology.

The Institutes of Psychology, Physics, Chemistry

and Engineering are located in Shanghai. That of psychology is the smallest, and at present its work is largely confined to neural physiology and anatomy. It is being moved to Nanking. The three other institutes are, however, in their permanent quarters, which form a two-story building with a total floor space of 75,000 sq. ft. built in 1933 at the cost of £50,000 (Fig. 2). Both physics and chemistry possess excellently equipped laboratories. In addition to pure research, efforts are being made to study local problems. Thus, in chemistry, work has been done on Chinese drugs, paper and glass-making, metallurgy of certain rarer minerals; in physics on wireless, X-rays and geophysical surveying; and in engineering on ferrous metallurgy and ceramics, the aim being the better utilisation of China's resources in industrialisation. Both the Engineering and the Physical Institutes maintain standards testing laboratories; the latter fulfils partly the function of a bureau of standards.

The Academia Sinica as a whole receives from the National Treasury a grant of £100,000. Together with the income from its reserve fund and other grants, its budget during the last few years has averaged about £150,000.

Obituary

Prof. Edwin B. Frost

EDWIN BRANT FROST, who died on May 14, was born on July 18, 1866, at Brattlebro, Vermont. His father, Carlton Pennington Frost, was the seventh in descent from ancestors who had left Ipswich, Suffolk, in 1634 in order "to avoid the more savage oppression of England". They were shipwrecked off Yarmouth, but the family started again in 1635, and after a voyage of fifty-three days they reached Boston, and settled in New Hampshire, Vermont and Maine. Edwin Brant Frost derived his second name from the wife of his paternal grandfather Benjamin, who had married Mary Catherine Brant. His early home was in the green hills of the valley of the Connecticut River. His father was surgeon-major for some months in the Civil War and for three years after it, and in 1871 he was called to a professorial chair in medicine at Dartmouth College, Hanover, New Hampshire. Thus it came about that his two sons spent their learning years at Dartmouth College.

Edwin B. Frost, the younger son, graduated as A.B. in 1886, in physics. In the following year he accepted an invitation from Prof. C. A. Young to go to Princeton. Young was then engaged in writing his textbook on general astronomy, and Frost gave help in reading the proofs—an admirable way of taking a course in astronomy. He became A.M. in 1889, and then came to Europe to continue graduate studies, first at Strassburg under Kohlrausch, and later at the Astrophysical Observatory, Potsdam, under Prof. H. C. Vogel.

At Vogel's suggestion, Frost made observations with a thermopile to study the distribution of radiation over the sun's disc for comparison with Vogel's earlier study of ultra-violet radiation. Nova Aurigæ was discovered by Anderson in February 1892, and during Dr. Scheiner's temporary illness Frost photographed the spectrum of the nova with a small improvised spectrograph attached to the Repsold astrographic refractor. He also took a share with Scheiner in the measurement and reductions of the photographs of the cluster in Hercules, taken with the same refractor.

On his return from Europe in the autumn of 1892, Frost took up work as instructor in physics at Dartmouth College, Hanover, and devoted spare time to the translation of Scheiner's textbook "Die Spectralanalyse der Gestirne" (1890). This translation with extensions was published with Messrs. Ginn and Co., in 1894, under the title "Astronomical Spectroscopy".

His participation in the research activities at Potsdam, however, had made Frost aware of possibilities remote from pedagogy. He became professor at Dartmouth College in 1896, and two years later he was appointed to the chair of astrophysics in the University of Chicago. In 1898 he joined the staff of the Yerkes Observatory at Williams Bay under the directorship of Dr. G. E. Hale, and he had among his fellow workers Barnard and Burnham and Dr. W. S. Adams. When Dr. Hale was searching (1903–4) for a site for solar observations for the Carnegie Institution, Frost was called on to undertake the duties of deputy director. In 1904 Dr. Hale resigned the directorship of the Yerkes Observatory, and Frost succeeded him as director in 1905.

Hale had designed and constructed the Rumford spectroheliograph, which was mounted on the Yerkes telescope. To Frost had been assigned in particular the duty of designing and using the Bruce spectrograph (1902), to replace the earlier spectrograph used by Hale and Ellerman, on the 40-inch refractor in their study of the spectra of stars of the Fourth Type. The general design of the instrument was prepared by Frost and Dr. Hale, and it was carried out under the superintendence of Mr. Ritchey in the workshops of the observatory. With this instrument, Frost and Dr. Adams secured their observations of the radial velocities of twenty stars of the Orion type (helium stars). Thus whilst Dr. Campbell at the Lick Observatory was attacking with splendid success the task of measuring the radial velocities of stars with well-defined lines in their spectra, Frost devoted his attention to stars of class *A* with less-defined lines,

and showed that such stars could be dealt with successfully. Hence it came about that velocity determinations have been accumulated for more than 500 stars, by the joint work of thirty-five observers, including Frost, Mr. Barrett, Mr. O. J. Lee and Dr. Otto Struve, who had joined the staff in 1922. Out of more than 4,000 photographs, Frost had taken about 9 per cent, Mr. Barrett about 37 per cent, Mr. Lee about 11 per cent, Dr. Struve nearly 23 per cent. Out of the 500 stars observed, 187 or 37 per cent were believed to be spectroscopic binary stars by reason of their observed variable velocities.

Besides editing in 1907 the solar observations of Dr. C. H. F. Peters made at Hamilton College, Clinton, N.Y. in 1860–70—a task involving labour out of all proportion, it must be confessed, to the scientific value or availability of the results—Frost published more than a hundred papers, mainly in the *Astrophysical Journal*, of which he was then active managing editor for twenty-seven years. Seven volumes of *Publications of the Yerkes Observatory* have appeared recording the work of many workers in diverse lines of astronomical activity. No wonder that with so much editorial work in the daytime, his eyesight suffered when he imposed on it also the strain of observational work at night. It was on December 15, 1915, that detachment of the retina declared itself, and with cheerful belittlement of his affliction, he used to estimate the gradual diminution of the percentage of normal vision left to him as years went by. He resigned the directorship of the Yerkes Observatory in July 1932.

Frost will be remembered with respect and affection by his many students and colleagues as a man of peculiarly genial nature in human relations, of very varied interests—natural history, botany, music, literature—and for his amazing courage and cheerfulness in carrying on his life's work in spite of the affliction of increasingly defective eyesight. A large circle of friends will join in deep sympathy with Mrs. Frost and her family, and in good wishes for the success of Dr. O. Struve in carrying on the directorship of the Yerkes Observatory.

News and Views

Past and Future of Chemical Industry

In his medallist's address to the Society of Chemical Industry at Glasgow on July 3, Dr. E. F. Armstrong briefly reviewed developments in chemical industry in the last twenty-five years, with particular reference to his own experiences with Crosfield's and Gossage's. Noting the unpreparedness of chemical industry for the Great War, although chemists and chemical industry came well out of that searching ordeal, he urged the importance of maintaining in peace time in active being those industries which in war will furnish the plants, the materials and the chemists necessary for war production. Another war might make even greater demands on our chemical resources, and modern mass-production plants cannot be improvised. Apart from the ability of the industry to expand rapidly to supply war needs, the availability of the technical personnel capable of handling intricate manufacturing processes as well as emergency problems is even more important. Dr. Armstrong directed attention to the tendency towards continuous processes, automatically controlled, and viewed with anxiety the future position of important products still made in Great Britain by batch processes. He referred to the systematic work required to secure the best results when a particular aggregation of plant has to be adapted to making several substances in turn, as in the colour industry, and briefly discussed the rationalisation of chemical industry as well as the formation and work of the Association of British Chemical Manufacturers and the effect of tariff changes on chemical industry.

Looking to the future, Dr. Armstrong advocated changes in the management of the Society of Chemical Industry, including a recognition of the ephemeral character of most of the meetings, papers and discussions, and a much stronger participation in public affairs by the chemist. The training of the chemist in industry is not finally complete without some study of management, and it is essential for the chemist to realise that management can be scientific, and although nothing can substitute personality a thorough knowledge of a subject is equivalent to power. Labour questions offer an important field for experiment in which chemical industry has already pointed the way, and a reduction in working hours, a later entry into industrial life as well as an earlier departure are all matters obviously desirable from technical as well as social and economic points of view. Dr. Armstrong made a powerful plea for more attention to the problems of the smaller firms, which could frequently be solved by closer co-operation particularly in development. It is probable that, in the future, allied industries will tend to become more and more chemical manufacturers, and the importance of the chemist thus to increase. Technical men must prepare themselves to meet the situation; there is a suspicion that the individual chemist has not progressed individually with his industry. It is essential to attract the best type of young men and to see to it that they are encouraged and adequately rewarded from the start.

Ecological Expeditions in East and West Africa

The Department of Botany at the British Museum (Natural History) has received 838 plants collected on the Cambridge Botanical Expedition to Nigeria by Messrs. P. W. Richards and R. Ross. The main object of the expedition was to make an ecological

survey of a limited area of West African rain-forest comparable with those previously made by Mr. Richards in Guiana and Sarawak. This meant a study of the floristic composition and structure of various types of primary forest on one hand, and a study of soil and micro-climatic conditions on the other. In addition, Mr. W. J. Fletcher Cambell made a general soil survey. Mr. Ross studied the succession of secondary forest on old farms and Mr. G. C. Evans worked on the growth, transpiration and assimilation of two species of undergrowth shrubs. The base camp was about five miles from Akilla in the Shasha Forest Reserve, Ijebu Province, and the area worked was mostly within a radius of five miles from the camp. Four months were spent here, and a visit, via the creeks, was made for a fortnight to Nikrowa in the Okomu Forest Reserve, Benin Province, where the rain-forest is said to be the finest in Nigeria. Collecting was mainly incidental to ecological work. The specimens are particularly rich in forest trees, and special attention was paid to Bryophytes. It was possible to fix a hygro-thermograph in a tree top eighty feet from the ground in primary forest and to take daily readings over a period of several weeks. A mud and bamboo laboratory was built with a dark room quite efficient for working with panchromatic plates.

THE collection of plants made by Mr. P. M. Synge on the British Museum Expedition to Uganda and Kenya has been received; it contains 1,231 numbers. Mr. Synge's main object was the study of vegetational zones in the higher parts of the East African mountains and the environmental factors influencing them. Particular attention was paid to the arborescent Senecios, and a long series was collected. Some observations were made on humidity and temperature in the higher zones, but a complete record could not be obtained. Dr. Taylor made the main collections on the joint visits to the Aberdare Mts. and Birunga Mts. Three visits were made to Mt. Elgon and one to Mt. Kenya, while the Nyamgasani valley on the south side of Ruwenzori was ascended and collections made up to the limit of vegetation. Some water plants and algæ were collected from the Nyamgasani lakes: a little collecting was also done in the papyrus swamp around Lake Kioga.

Archæological Exploration in Africa

PROF. LEO FROBENIUS, president of the Frankfurt Research Institute for Cultural Morphology, who has recently returned from his twelfth expedition to Africa, claims, it is said, that the results of his explorations in the Libyan Desert and the Sudan have now established the validity of his theories of the origin and direction of diffusion of the periods, or phases, which he distinguishes in the history of civilisation. It will be remembered that Prof. Frobenius, working on the material which he has been engaged in collecting in Africa for nearly thirty years, has not only produced an elaborate classification and scheme of distribution of the main forms of culture in that continent, but has also put forward certain views as to their historical development and affiliations. In an interview with the correspondent of *The Times*, which appears in the issue of July 31, Prof. Frobenius is reported as saying that he has now discovered in the Neolithic of the Sudan, the period in which agriculture and the domestication of animals first appear, the missing, but essential, link in the chain of evidence joining prehistoric to historic cultures. It is further reported that, since October last, a staff of twenty research workers attached to the Institute and distributed from Scandinavia to Southern Rhodesia, including France, Spain, Italy, North Africa, Abyssinia and Arabia, has been engaged in filling in gaps in the evidence and adding details to the chart of cultural distributions, which is now approaching completion.

FURTHER particulars are now to hand of an archæological discovery in Tanganyika reported early in July. According to a dispatch from Nairobi in *The Times* of August 1, Commander Nino del Grande, leader of an expedition collecting snake poison for the preparation of a snake-bite serum, camped for five days on the site of the ancient city discovered near Nguruka. He reports that the city is four and a half miles long by one and a half miles broad and is constructed terrace-wise on the wall of the Great Rift escarpment. Remains of houses, estimated to number four thousand, were found. Each had three or four rooms and stone walls four feet in thickness. Large stone tombs, one containing a skeleton, were found in the valley below. It is given as the opinion of Commander del Grande that no very high antiquity is to be assigned to these remains. It is thought that they may be about five hundred years old and the work of an advanced tribe, possibly the ancestors of the Wambulu now living some fifty miles away. The site is being examined by Dr. L. S. B. Leakey, whose verdict on the relation of these remains to other vestiges of stone structures found in various parts of East Africa should be of signal importance for the cultural history of the southern half of the continent.

Excavations in the Fens

THE importance of intensive exploration of the Fens, which led to the formation of the Fenland Research Committee at Cambridge, under the presidency of Prof. A. C. Seward, has already been referred to in these columns. Some of the results already obtained are now on exhibition at the British Museum, Bloomsbury, at the head of the main staircase. The sites selected are mostly between March and Mildenhall, and more or less connected with the Ouse, Cam and Bedford Rivers, where the post-glacial period is represented by peat, clay and silt, in which a sequence of human occupations can be traced, while light is further thrown on land movement and forest development. Waterways and promising sites have been traced by surveying on the ground and from the air, and an interesting feature is the occupation in Roman times of what used to be river banks but are now parallel mounds flanking slight depressions, in which shrunken rivers originally flowed. The contraction of the peat

has left these banks in relief, and the amount of this wastage is indicated by the Holme post, which proves that Whittlesea Mere is about 11 ft. lower than in 1848. The co-operation of workers in many fields has been secured, and much attention given to the botany, geology and zoology of the region, which is linked to North Germany and Scandinavia by its foraminifera and tree-pollen, to say nothing of changes in relation to sea-level. The work supervised by Dr. Grahame Clark in association with Mr. C. W. Phillips and Major Fowler has been rendered more difficult by the presence of water in the deeper cuttings; but funds have been provided, mainly by the Percy Sladen Memorial Fund, and the present exhibition, which will be open at least two months, will reveal to a larger public the potentialities of the Fens as a field of research in various branches of science.

Iron Age Site on the Sussex Weald

A FURTHER addition to the sites of industrial activity in Sussex in later prehistoric and Roman times, for which archæologists are indebted to the activity in investigation of Mr. S. E. Winbolt, is made by the discovery of an Early Iron Age camp on the Weald in Piper's Copse, one and a quarter miles east of North Chapel, West Sussex. The situation is remote and the discovery was due to the fact that a fox had dug its earth in a dry place where a small iron smelting hearth had been constructed in the inner slope of a bank. This was found on investigation to be the north-west end of an enclosure formed by a bold bank and deepish ditch, in good condition, except on the south-east, where an attempt had been made at levelling. The dimensions of the camp, Mr. Winbolt states in a communication to *The Times* of August 5, are a little more than 300 ft. by 270 ft. outside measurement, the inner area comprising about 1¼ acres. The height of the rampart, where best preserved, is 14 ft. from the bottom of the ditch. Two points of special interest arise in connexion with this discovery. The camp lies on the Wealden level (*c.* 120 ft.) and although Early Iron Age camps are known on heights fringing the Weald, such as at Holmbury and Hascomb, Saxonbury and Dry Hill, this is the first to be recorded at the Wealden level. The second point of interest is its date and purpose. These are fixed by red burnt material, charcoal, nodules of local iron ore and five fragments of La Tène iii pottery, as well as by many big lumps of iron ore lying near by. The site lies about two miles from the eastern slope of Blackdown near a stream flowing into the Arun and is in the middle of a country rich in iron ore of a moderate quality, where iron furnaces and forges of late medieval date abound, as, for example, at Mitchell Park, Shillinglee, Ebernoe and Roundwyck. Mr. Winbolt points to this as a further instance of the previous existence of Iron Age and Roman iron workings where medieval and Tudor workers are found.

Science and Culture: A new Indian Monthly

IT was anticipated by the founders of the Indian Science Congress that the Congress would stimulate in India an interest in science and in scientific research. At the time of its formation, the reforms in Indian university education resulting from the recommendations of the Curzon Commission were becoming effective and the universities were beginning to be centres of research. The spirit of scientific inquiry grew during the War period, and if the formation of scientific societies and the issue of scientific journals are to be regarded as criteria of increased interest in science, the hopes of the founders of the Congress have been fulfilled. There are in existence a number of specialist societies, the most recent addition being a Physical Society, and we referred recently (**135**, 410, 441; March 16, 1935) to the foundation of the National Institute of Sciences of India with its affiliated academies, the Asiatic Society of Bengal, the U.P. Academy of Sciences (Allahabad), and the Indian Academy of Science (Bangalore). In so large a country as India it is natural that there should be more than one academy, but the choice of names for these bodies is not happy and is likely to cause confusion in references to their publications.

THE more general aspects of science have in the past been dealt with by the weekly periodical *Current Science*, and we have now received the first issue of a monthly journal, *Science and Culture*, published by a non-profit corporation in Calcutta. The object of this periodical "is the dissemination of scientific knowledge amongst the public and advocacy of its application to all walks of life as far as practicable". The first issue contains a number of valuable articles the majority of which deal with topics of local interest, but the lecture by Prof. M. N. Saha "Ultimate Constituents of Matter" will attract a wider public. There are, in addition, reviews of books and a correspondence column. The latter, containing preliminary accounts of scientific investigations, seems scarcely in keeping with the other contents. These 'letters to the editor' would have appeared more suitably in *Current Science*. We welcome this new periodical, and if the high standard of the first number be maintained its success is assured.

British Empire Naturalists' Association in Jersey

IN the official report of the summer meeting of the British Empire Naturalists' Association in Jersey, Mr. Leslie Beckett, honorary organising secretary of the Association, states that many rare plants and birds were observed. Particularly was the island fruitful in flora, and of the more interesting examples noted, mention is made of many plants rare or unknown in England but quite well established and safe in Jersey; for Jersey is the northern limit of many Continental and North African plants. The English or five-spotted catchfly (*Silene gallica*) was found in profusion nearly everywhere, and near Crabbe, the party found the rare variety, *quinquevulnera*, which few of the botanists present had seen before. One party found a big patch of the Jersey bugloss (*Echium plantagineum*) between St. Brelades and Corbière. On the sand-dunes near Le Pont was found the rare yellow broomrape (*Orobanche ritro*) which is not found elsewhere between this

locality and Spain. On the last afternoon of the fortnight, *Convoluta Roscoffensis* was noted, an extraordinary example of symbiosis between a worm and an alga. Of bird-life, Mr. Le Maître led a party to the cliffs at Crabbe, to photograph the herring-gullery there, and the Rev. Pere Burdos led a party to the Pinnacle, a rock 200 ft. above sea-level near Plemont, where the peregrine falcon, raven, puffin and nesting guillemots, razorbills and oyster-catchers were seen. The granites in which Jersey is so rich interested the geologists, and while studying a quarry near Gorey Castle the rare hyssop-leaved loosestrife plant was noted. The first meeting of the London branch of the B.E.N.A. will be held at the Furnival Hall, Furnival Street, on October 16, when Mr. J. Ramsbottom will lecture on "Moulds and Mushrooms".

Technical College Buildings

IT is little less than astonishing that a country like Great Britain, which has been the pioneer in scientific work and retained so high a standard of scientific achievement, should have such a paucity of literature dealing with material needs in the matter of buildings and equipment necessary for its field of activity. Books dealing with laboratories can be counted on the fingers, while for any wide general account of technical institutions dealing with the application of science to the trades, it is necessary to go back nearly half a century. The report, published at the expense of the Carnegie United Kingdom Trust, by a Joint Committee of the Association of Technical Institutions, the Association of Principals of Technical Institutions with representatives of the Royal Institute of British Architects and the Institute of Builders and a member of the staff of the Board of Education is therefore to be specially welcomed, particularly at the present time when the demands for buildings for technical education are so marked (London : Association of Technical Institutions and the Association of Principals of Technical Institutions, 1935. 3*s*.) The volume, consisting of some 150 quarto pages including plans and illustrations, is the work of a representative committee the personnel of which is sufficient evidence of authority. The opening two chapters deal with general requirements including service supplies and accommodation, and these are followed by concise articles on the special needs of specific subjects, some twenty in all, embracing such fields as leather industries, printing and textiles in addition to the more generally taught trade principles. These chapters, which occupy the bulk of the volume, have been compiled by panels of experts intimately associated with the required tuition. The brochure concludes with two chapters illustrated with plans and photographs of recent British and Continental examples of buildings, and should be of great value to all concerned with the development and execution of schemes for technical education.

Temperament in Industry

THE effects of having the wrong type of persons in positions of authority were discussed by Dr. May Smith, senior investigator to the Industrial Health Research Board, in a lecture on May 27 forming part of a course on the temperamental factor in industry arranged by the National Institute of Industrial Psychology. She said that it was not uncommon to find that a high rate of sickness absences was the result of having a supervisor with the wrong temperament for his job. Sickness is also frequently ascribed to overwork, but overwork itself is often the result of having to deal with the unreasonable demands of heads who are irrational and lack emotional balance. After dealing with various temperamental types who cause trouble when they are in important positions, Dr. May Smith outlined the attributes of a good head. Assuming that he has the necessary intellectual powers and technical knowledge, the first requirement is a sense of justice—a capacity for asking, not "Am I receiving justice ?" but "Am I giving it ?" A good head must create the knowledge that everyone under him will receive fair treatment. A second quality is vitality, explaining that she meant not physical exuberance, which is often exhausting to subordinates, but the controlled energy that inspires them. "The 'Weary Willy' and the 'Streak of Misery'," she said, "should have no place at the head." The next requisite is the ability to regard people and things dispassionately, to see them as they really are, and not merely as they happen to appeal to the man himself. A sense of humour is the next requisite, to prevent the head taking himself too seriously. Finally, the good head must be able to rule without straining his powers on one hand or shirking responsibility on the other. Temperamental factors in industry do not receive sufficient attention in Great Britain, and it is a pity employers and departmental managers do not receive training in handling personalities. 'Nagging' might well be made a capital offence !

The Government Laboratory

FEW, apart from those who study the annual report of the Government Chemist, are well acquainted with the character and volume of the work which is carried out at the Government Laboratory. A detailed and illustrated account of the activities of this laboratory has recently been published in the *Chemist and Druggist* ; since much of the information which relates to processes and figures has been supplied to the author, the article can be accepted as an accurate and fully informed review. The Department of the Government Chemist, in its capacity of a protector of the revenue, undertakes the routine analysis of large numbers of samples of dutiable goods, handling, for example, some 5,000 samples of tobacco every week. As a public servant assisting in suppressing adulteration, it acts as a referee when reports of public analysts are challenged. The samples concerned have frequently undergone changes by the time they reach the laboratory—this applies particularly to samples of milk—so that the necessary analytical procedure is much more elaborate than normally. Such considerations involve a good deal of research, leading to the working out of satisfactory analytical methods. Another function

of the Department is that of acting as an adviser to the State on chemical matters, of taking part in international studies on the mass-movement of the sea from place to place, and of examining samples submitted by other Government departments. In addition to the principal laboratory at Clement's Inn Passage, other laboratories under the control of Sir Robert Robertson are the Custom House laboratory, and laboratories at the Geological Survey, at the Army Supply Depot at Deptford, at Park Royal, and at five seaports. The public thinks of these laboratories as places where a great deal of 'testing' is carried out; chemists, however, know that in addition they house a vigorous research organisation, only part of the work of which can, in the public interest, be published in the scientific journals as notable contributions to the common stock of chemical knowledge.

Harrison's Chronometers at the Science Museum

THE Admiralty has kindly lent to the Science Museum, South Kensington, all four of the pioneer marine timekeepers made by John Harrison between 1729 and 1759. With these instruments Harrison was the first to show that it was possible to construct a portable timekeeper which would keep sufficiently accurate time at sea to be of use in determining a vessel's longitude, and thus solved the problem of 'finding the longitude' which had baffled men of science and inventors for more than two hundred years. Harrison's instruments were the first balance-wheel timekeepers to embody any kind of compensation for the effects of change of temperature. In all four of his instruments compensation is provided by varying the effective length of the balance-spring, the mechanical details varying in the different individuals. In the first three timekeepers, the effect of the ship's motion is also compensated by employing two balance-wheels connected together by an ingenious but delicate system equivalent to a frictionless gearing; in the fourth chronometer, however, this system is abandoned in favour of a single small balance-wheel the angular acceleration of which is large compared to the stray accelerations due to the ship's motion. The first three chronometers are large clocks each weighing more than fifty pounds, but the fourth is much smaller, being essentially a large watch about five inches in diameter. All four instruments have been cleaned, repaired and put into working order by Lieut.-Commander R. T. Gould, and they are now on exhibition in the Museum, in going condition.

National Park in Snowdonia

SIX months ago public interest in Snowdonia as a national park was revived by the offer made by Mr. C. Williams-Ellis to the National Trust of 300 acres near Nant Gwynant with covenants to preserve the rest of Hafod Lwyfog farm in its present condition, provided others would co-operate in taking further steps for the preservation of this beautiful area. Since then the Caernarvonshire County Council has taken active steps towards the preparation of a planning scheme covering the whole area. Now, through the generosity of an anonymous benefactor, a scheme has been formulated by the National Trust for the preservation of the Aberglaslyn Pass. The anonymous benefactor has provided the funds for the purchase from the Snowdon Mountain Railway, Ltd., of the east side of the pass, provided the Trust can secure the co-operation of the owners of the land on the west side. The owners of Plas Aberglaslyn on the west of the Pass and Mr. Clough Williams-Ellis as owner of a small area to the south have immediately agreed, and the National Trust is now confidently awaiting the assurances of one or two other contiguous owners before completing the purchase. It is further believed that another offer of land between Gwynant and Pont Aberglaslyn is likely to be made.

Medical Botany of the Eighteenth Century

MR. H. S. REDGROVE contributes an interesting article to the *Gardeners' Chronicle* of May 11 describing a very complete work on "Medical Botany, containing Systematic and General Descriptions, with Plates, of all the Medicinal Plants, indigenous and exotic, comprehended in the Catalogues of the Materia Medica, . . . accompanied by a Circumstantial Detail of their Medicinal Effects, and of the Diseases in which they have been most successfully Employed". This remarkable work was from the pen of Dr. William Woodville (1752–1805). It was published first in monthly parts, but later in three volumes and a supplement (1790–94). Woodville's life is described briefly in the article under review, and his peculiar qualifications for the work are emphasised. One cannot but feel regret, as Mr. Redgrove quotes passages from "Medical Botany", that such herbs as *Potentilla erecta* have passed from medicinal use, for their employment seems to have been determined by very exact knowledge. 210 drawings by Sowerby were included in the work, which was written in a thoroughly scientific spirit.

Common Names for Plant Diseases

DIFFICULTIES of expression by written word are great, even when words have exact literary meanings. The words of a new science like plant pathology have been coined by practical growers in different places and under varying conditions, so it is not a matter of wonder that much confusion has resulted. The second edition of the "List of Common Names of British Plant Diseases" (Cambridge: University Press. Pp. 95. 2*s*. 6*d*. net) represents a serious attempt to standardise nomenclature of disease symptoms and causal agents. It has been compiled by the Plant Pathology Committee of the British Mycological Society. The list is in two columns—first the common name and then the name of the parasite. Synonyms are given where necessary, but the volume is a well-regulated attempt to establish one name for each disease. Many synonyms are being discouraged, whilst in one or two cases fresh names have been introduced for the sake of clarity. The host plants are grouped conveniently into

vegetables, cereals, fruit, ornamental plants, etc., whilst the causal agents are listed in the order—Viruses, Bacteria, Myxomycetes, Phycomycetes, Ascomycetes, Basidiomycetes, Fungi Imperfecti, and Non-parasitic. Foreign names are also given where possible. The comprehensive orderliness of the list should commend it for universal adoption.

Acta Physicochimica U.R.S.S.

THE publication of the *Acta Physicochimica U.R.S.S.* commenced in September 1934, and volume I containing six parts has just been completed. In Russia as in other countries, the ramifications of chemistry, especially in its mathematical and physical aspects, are growing so complex and varied that it is found desirable to have as a medium for publication, in addition to the usual journals devoted to chemistry, a special one devoted to the more advanced aspects of physical and theoretical chemistry. We have noted the recent appearance of the *Journal of Chemical Physics* in the United States, the remarkably effective and somewhat sudden renaissance of the *Transactions of the Faraday Society* in Great Britain, and now the appearance of the *Acta Physicochimica* in Russia. The board of editors of the journal is certainly to be congratulated on the first six parts. It would appear that the referees appointed by the board function admirably in that country in selecting suitable—and presumably also in rejecting unsuitable—material. A number of internationally well-known names, including those particularly well known in England, Profs. Frenkel, Frumkin, Rabinovitch, Semenoff and Talmud, are to be found on the board, and there is a list of some forty permanent contributors distributed over seven cities of the U.S.S.R. Although new journals furnish problems both in budgeting and in library accommodation, these difficulties will be overcome at least for this admirable example of a specialised scientific journal.

Insects of Samoa

THE British Museum (Natural History) has recently issued further instalments of the publication entitled "Insects of Samoa", a work which has been noticed from time to time in these columns. Part 6, Fasc. 8 of the complete work, by Mr. J. R. Malloch, of the U.S. Bureau of Biological Survey, deals with some further groups of Acalypterate flies, namely, the families Drosophilidæ, Ephydridæ, Sphaeroceridæ and Milichiidæ, and is illustrated by 16 text-figures. In Part 6, Fasc. 9, Mr. Malloch discusses certain families of Cyclorrhaphous flies, namely, Phoridæ, Agromyzidæ, Micropezidæ, Tachinidæ and Sarcophagidæ (supplement). Dr. H. H. Knight, of the Iowa State College, deals with the hemipterous families Miridæ and Anthocoridæ (Part 2, Fasc. 5), which comprise 21 genera and 33 species. Part 3, Fasc. 4 is by Mr. W. H. T. Tams of the British Museum (Natural History), who contributes a lengthy section comprising all the Heterocera, excepting the Geometridæ and Microlepidoptera, which have already been reported upon. Mr. Tams's report more than trebles the number of Samoan moths represented in the British Museum. It also contains important observations on nomenclature and upon the grouping of the sub-family divisions of Heterocera.

Field Museum of Chicago

THE economic situation in the United States is bearing heavily upon institutes such as museums which depend largely upon the goodwill and financial aid of the people. The annual report for 1934 of the Director of the Field Museum of Natural History shows this clearly. Income, from endowments, tax collections, admissions and membership, was in each case reduced, so that a total of 491,002 dollars stands against 636,318 for 1933. Visitors have fallen from more than three millions in 1933 to less than two millions in 1934, though the earlier year's numbers were abnormally increased by the opening of the "Century of Progress Exposition" in Chicago. In spite of difficulties, the Field Museum continues to prosecute research in various fields, though these are now limited to privately financed expeditions; it has added notable groups of animals to its public galleries; and it continues by means of lectures (attended by some 662,000 persons, mostly children) and by travelling natural history exhibits (to more than four hundred schools) to educate the youth of Chicago biologically.

Examinations in Milk Processing and Control

THE City and Guilds of London Institute has arranged to hold examinations in the future, commencing May next year, in milk processing and control, with certification of successful candidates. It is hoped that the provision of the examinations will encourage the formation of classes of instruction in these subjects in different parts of Great Britain, so that those engaged in the milk industry who receive such instruction should be in a position to render more efficient service. It is proposed that the examinations should be held at approved centres in Great Britain, Ireland and overseas. The syllabus of the examination for the certificate, which will be in two parts, intermediate and final, has been drawn up by a representative advisory committee, and may be obtained from the Superintendent, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, South Kensington, London, S.W.7.

The Seismological Station of De Bilt

WE have received the valuable report on the earthquakes recorded at this well-known observatory during the year 1932. The instruments include horizontal and vertical component Galitzin seismographs and also Wiechert and Bosch seismographs. In addition to a catalogue of 437 earthquakes, the report contains an appendix on the earthquakes in North Brabant during November 20–28, 1932. The principal earthquake occurred on November 20 and was felt all over the Netherlands, in Belgium and west Germany, and even, it is said, in London. Its epicentre (in lat. 51° 40′ N., long. 5° 35′ E.), as well as the epicentres of three strong after-shocks, lay close to the boundaries of the central rift-valley.

T. K. Sidey Summer-time Award

It is announced that the second award of the T. K. Sidey Summer-time Medal and Prize will be made by the Royal Society of New Zealand at its annual meeting in May 1936. The award, which comprises a medal and a prize of £100, is made for the most valuable contribution or contributions to human knowledge by research in the study of light visible and invisible and other solar radiations in relation to human welfare. Applications will close with the Secretary of the Society on February 29, 1936. Theses specially prepared or copies of published works may be submitted. The first award of this medal was made to Lord Rutherford in 1933.

Melbourne Meeting of the British Medical Association

The annual meeting of the British Medical Association will be held in Melbourne on September 9–14, under the presidency of Sir James Barrett, deputy chancellor of the University of Melbourne. The meeting will be divided into the following sections, with the sectional presidents indicated: Medicine, Lord Horder; Surgery, Sir Thomas Dunhill; Obstetrics and Gynæcology, J. S. Fairbairn; Radiology and Radiotherapeutics, H. M. Moran; Diseases of Children, Dr. Robert Hutchison; Neurology and Psychological Medicine, Prof. E. Bramwell; Ophthalmology, Dr. A. J. Ballantyne; Orthopædics, Prof. E. W. Hey Groves; Oto-Rhino-Laryngology, Francis Muecke; Pathology and Bacteriology, Prof. A. M. Drennan; Pharmacology, Therapeutics and Anæsthesia, Sir William Willcox; Public Medicine, including History of the Development of Medicine in Australia, Sir Henry Gauvain; Dermatology, Dr. S. Watson Smith; Medical Sociology, Dr. E. Kaye Le Fleming. The honorary local general secretary is Dr. J. P. Major, Medical Society Hall, Albert Hall, East Melbourne, C.2.

Announcements

Dr. E. J. Butler, director of the Imperial Mycological Institute, has been appointed secretary to the Agricultural Research Council, in succession to Sir William Dampier. Sir William will be appointed a member of the Council as from the date of his resignation of the secretaryship on September 30.

The Medical Research Council has awarded Dorothy Temple Cross Fellowships for the academic year 1935–36, under the terms of the benefaction in that name for research fellowships in tuberculosis, to the following:—Dr. G. B. Brook, senior assistant veterinary officer, Derbyshire County Council; Dr. J. W. Craig, assistant medical officer, King Edward VII Sanatorium, Midhurst, Sussex; and A. H. B. Rhodes, house physician, Brompton Hospital, London.

Busts of Robert Koch and Conrad Rontgen have recently been placed in the Deutsches Museum at Munich on the occasion of the tenth anniversary of its foundation.

Among various other works of anti-aircraft defence, the Municipality of Prague has decided to build a subterranean hospital containing several hundred beds.

Dr. Arthur Meyer, head of the publishing firm of Johannes Ambrosius Barth at Leipzig, has been awarded the Goethe Medal by the German Chancellor in recognition of his services to German scientific literature. He has also been made a doctor *honoris causa* by the medical faculty of the University of Leipzig.

The German Society of the History of Medicine, Natural Science and Technique will hold its annual meeting at Bamberg on August 29–September 2. Further information can be obtained from the secretary, Dr. Walter Artelt, Institut für Geschichte der Medizin und Naturwissenschaften, Universitätsstrasse 36, Berlin, N.W.7.

Applications are invited for the following appointments, on or before the dates mentioned:

A chief lecturer in engineering in the Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth (Aug. 17).

A technical officer in the Meteorological Office—The Secretary (S. 2. E.), Air Ministry, Adastral House, Kingsway, W.C.2 (Aug. 22).

An inorganic chemist on the staff of the British Scientific Instrument Research Association, 26, Russell Square, London, W.C.1—The Director of Research (Aug. 23).

A lecturer in mathematics in the University of Reading—The Registrar (Aug. 26).

Lecturers in mechanical engineering and mining engineering in the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (Aug. 26).

A dairy bacteriologist at the County Council Farm, Hutton, near Preston—The Director of Education, County Offices, Preston (Aug. 30).

An assistant lecturer in zoology in the University of Leeds—The Registrar (Aug. 31).

An assistant Government analyst in the Straits Settlements—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Aug. 31).

A secretary to the Institution of Naval Architects—Council, Institution of Naval Architects, 2 Adam Street, W.C.2 (Aug. 31).

A head of the Engineering Department and the Junior Technical School, Municipal Technical College, Blackburn—The Director of Education, Education Offices, Blackburn.

A dairy instructor at the Farm Institute, Sparsholt, near Winchester—L. G. Troup, Agricultural Organiser, 82 High Street, Winchester.

A municipal engineer at Jaffa—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1, quoting M/3786.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 226.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Dentition of *Ornithorhynchus*

IN 1888 Poulton, when examining some sections of the head of a young platypus, made the very important discovery of true calcified teeth. In the upper jaw he found evidence of four teeth, and he believed that four would also be found in the mandible. He also says: "I think that it is probable that the rudiments of teeth may be found anterior at a much earlier stage".

Oldfield Thomas and C. Stewart showed soon after Poulton's discovery that the calcified teeth are functional until the platypus is about half-grown.

In 1907 Wilson and Hill, by the study of two stages earlier than Poulton's specimen, added much to our knowledge of the developing teeth. They found evidence of four upper and five lower teeth, and also of a small calcified tooth of an earlier set than the functional teeth—clear evidence of a dental succession.

FIG. 1. Sections across (*A*) bud of supposed anterior lower incisor, (*B*) enamel organ of supposed lower canine, in very young *Ornithorhynchus*. × 80.

I have recently been examining sections of the head of a stage a little older than Wilson and Hill's younger specimen, and have just discovered a few interesting new facts. In what may be called the molar region, there seems little doubt that there is evidence of six teeth in both the upper and the lower jaws. Following the nomenclature of Wilson and Hill, these may be called *u*, *v*, *w*, *x*, *y* and *z*, and the functional teeth of the adolescent animal are *w*, *x*, *y* above and *x*, *y*, *z* below. Connected with *v* above and below there is clear evidence of a tooth of an earlier set, as found by Wilson and Hill, and I think the condition of the epithelium at the necks of *w* and *x* show indications of a *dw* and *dx* both above and below.

The most interesting discovery I have made, however, is some anterior teeth which have not, so far as I can learn, been previously seen.

In the upper jaw there is no dental lamina or any indication of teeth in front of the tooth germ *u*. But in the lower jaw in front of *u* we have a short distance with no dental lamina, and then an anterior portion of dental lamina with apparently the germs of three teeth. As might be expected in dealing with rudimentary structures, there is a slight difference in the two sides. On the right side the most anterior germ, which may be called *a*, is a well-marked little dental bud. Behind it is a second, *b*, and then we have a much better tooth germ *c*. This latter has quite a distinct enamel organ. On the left side, the tooth germ *a* is less developed and the tooth *c* a little better developed.

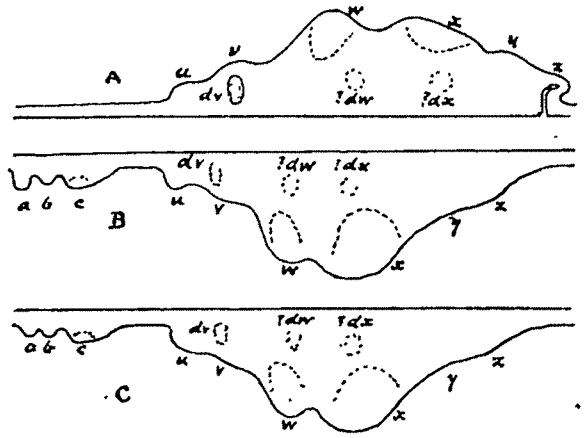

FIG. 2. Reconstruction of the dental laminæ of young *Ornithorhynchus*, length from snout to tip of tail about 90 mm. Dental laminæ of (*A*) upper jaw, (*B*) right mandible, (*C*) left mandible (reversed). × about 40.

These anterior teeth cannot, I think, belong to the premolar or molar set, and are evidently either three incisors, or more probably two incisors and a canine.

Fig. 1 includes a section through the right *a* and the right supposed canine. It will be observed that in the canine there is evidence of the dental lamina in addition to the enamel organ, and there is also evidence of the dental lamina by the side of the rudimentary supposed incisors. So that it seems probable that, in the case of both the supposed incisors and canine, there has been a dental succession in the ancestor.

The full dentition of *Ornithorhynchus* seems to be:

$$i\,\frac{0}{2}\;c\,\frac{0}{1}\;pm\,\frac{4}{4}\;m\,\frac{2}{2}.$$

This evidence does not help us very much towards the solution of the problem of the affinities. But it seems to show that *Ornithorhynchus* is descended from a form which had a full dentition, such as an Ictidosaurian or a Pantothere, rather than from a Multituberculate which had early lost the canines.

Transvaal Museum, Pretoria. R. BROOM.

Induced Radioactivity of Fluorine and Calcium

In an earlier paper[1], I have shown that sodium and phosphorus become radioactive under bombardment with alpha rays, presumably corresponding to the creation of Al^{26} and Cl^{34} respectively. In the case of phosphorus, chemical separation of the active body, kindly carried out by Prof. S. Sugden, gave strong support to this picture. Between these two unstable isotopes lies a third one, P^{30}, found by Curie and Joliot[2]. It was pointed out that another link of that chain, Na^{22}, should be produced by bombarding fluorine with alpha rays. Since the periods of the three above-mentioned bodies decrease rapidly with atomic number, a very short period was anticipated for Na^{22}. The search for this substance was unsuccessful, however, although periods so short as one tenth of a second would have been detectable by the method applied.

About that time, the emission of positrons from fluorine under alpha-ray bombardment was reported in a paper by L. Meitner[3]. The positrons were observed only during bombardment, and no life period was given. This was generally taken as evidence for a very short period. However, the very low energy of the positrons, as measured by Meitner, rather seemed to point to a long period. On inquiry, I was kindly informed by Prof. Meitner that no attempt at all had been made to measure the period, simply because the experiments had been carried out before the discovery of induced radioactivity. I have therefore recently taken up the search for an isotope Na^{22} of long period.

Through the courtesy of the Committee of the Radium Institute and Finsen Hospital, I was enabled to use radon in quantities up to 600 millicuries as the source of alpha rays. The radon was put into small glass vessels with a thin mica window which reduced the range to about 6 cm. Upon bombarding calcium fluoride, fairly strong effects were obtained at once; other calcium compounds, however, gave similar effects. The search for Na^{22} was therefore continued with sodium fluoride and lithium fluoride. In both cases weak activity was observed after prolonged bombardment. A chemical separation, kindly carried out by Prof. G. von Hevesy, showed that the active body follows the reactions of sodium, and therefore is presumably Na^{22}.

In striking contrast with the first anticipations, the outstanding feature of this new activity is its long period. One sample has been under observation for three weeks, with no evidence of decay. It may be concluded that the half-period must be at least six months. This explains the apparent weakness of the effect; indeed, with a few days' bombardment, only a fraction of the equilibrium activity is obtained. On the other hand, a reasonable assumption about the equilibrium activity leads to an estimated life of from one to several years.

The particles emitted from Na^{22} were shown by magnetic deflection to be positrons. They are rapidly absorbed in aluminium, the half-value thickness being about 0·03 gm./cm.^{2}. This corresponds to a mean energy of about 2×10^5 electron-volts, in good agreement with the results of Meitner.

The activity produced in calcium has also been studied. The half-period is 4·4 hours, with a possible error of ten per cent. The particles emitted are positrons, and their half-value thickness of aluminium is about 0·06 gm./cm.^{2}. From the great intensity, one may say that the effect is due to the main isotope of calcium, Ca^{40}. Capture of the alpha particle, with subsequent emission of a proton or neutron, would lead to the formation of Sc^{43} or Ti^{43}, respectively. A chemical separation, kindly carried out by Prof. G. von Hevesy, showed that the active body follows the reactions of scandium. Therefore the 4·4 hours activity certainly corresponds to Sc^{43}. Of course, it cannot be excluded that in the first instance Ti^{43} may be formed, and quickly transformed into Sc^{43} by emission of a positron. No short-period activity, however, could be detected.

O. R. Frisch.

Institute for Theoretical Physics,
Copenhagen.
July 3.

[1] Nature, 133, 712; 1934.
[2] Nature, 133, 201; 1934.
[3] *Naturwiss.*, 22, 420; 1934.

The Rate of Photosynthesis

The recent correspondence on photosynthetic rates[1,2,3] has emphasised numerous significant facts now known about the process. A few important ones still remain. They can be roughly summarised by saying that the equations proposed seem to contain no term for the plant.

In the proposals of Burk and Lineweaver[2] the symbol (CO_2) is used without qualification, and the authors say that their equation provides for hyperbolic relations between y (rate) and (CO_2) "in accordance with experiment". Presumably, therefore, (CO_2) is to be read as the external and measurable concentration of carbon dioxide. But this cannot be the effective concentration in their reaction (I)

$$\text{Chl} + CO_2 \rightleftharpoons \text{complex}.$$

I have been able to show[4] that the rate of photosynthesis can be made to vary considerably when all other conditions are kept constant and only the method of supply of carbon dioxide varied. Shortening the external diffusion path increases the rate, but there always remains the distance (measurable in μ) between the outer cell surface and the chloroplast. With moderate carbon dioxide concentrations and intensities of light, this is never negligible[5]; moreover, even the conception of a constant concentration right up to the cell surface is entirely 'ideal' and not realised with any plant. Allowing for these conditions, the equation

$$C_e = \frac{RK'}{A-R} + dR$$

will give a close fit to the observed rates, where C_e is the initial external concentration; R the rate; K' the dissociation constant of the chlorophyll-CO_2 complex; A, a constant independent of C_e, but varying with light, and d a resistance term including, but probably not solely depending on, the resistance to hydro-diffusion. The full derivation of this equation I have already given elsewhere[6].

A further difficulty resulting from structural considerations occurs in the absorption of light. A linear relation between light intensity and rate of the primary photochemical reaction may be a permissible approximation in simple cases; but it is more doubtful whether we are entitled to carry over this assumption to a wide range of plants with their exceedingly complex light-absorbing surfaces. We are here also faced with a complication, first

pointed out, I believe, by G. E. Briggs[7]. It is highly improbable that photosynthesis depends on a single photo-reaction of unit quantum efficiency, since it would appear that there is no quantum in the visible spectrum large enough to meet the minimal energy requirement. Experimental measurements[7,8] indicate a possibility of a value as low as 0·2 for the overall reaction. It seems to me that we must, therefore, assume either a photo-reaction not obeying the Einstein rule, or a series of n photo-reactions (n might be as high as 5), or a gain of energy in a thermal reaction. Since the great bulk of the light falling on a leaf is transformed to heat, there is no difficulty about a source of such energy. The first two of these alternatives certainly would, and the third might, necessitate changes in the proposed schemes.

It is impossible to contemplate this field of work without wondering whether the present position justifies the application of some of the kinetic assumptions employed. Realising the approximations and 'idealisations' inevitable, it is amazing that prediction gets as near the truth as it sometimes does. In such complicated systems the possibilities of errors compensated into rough agreements appear manifold. Recent careful work[9] even makes doubtful the existence within the plant of the 'steady states' which are the very basis of the analyses quoted by the correspondents in NATURE. It is clear that 'diffusion', 'reaction' and other 'constants' cannot here be given their usual significances, if only because they differ from plant to plant. It would appear that much pedestrian work on specific plants remains to be done before we can approach accurately based semi-quantitative generalisations.

W. O. JAMES.

Department of Botany,
Oxford.
June 21.

[1] Baly and Morgan, NATURE, 133, 414; 1934.
[2] Burk and Lineweaver, NATURE, 135, 621; 1935.
[3] Emerson and Green, NATURE, 134, 289; 1934.
[4] James, *Proc. Roy. Soc.*, B, 103, 1; 1928.
[5] van den Honert, *Rec. Trav. Bot. Néerl.*, 27, 149; 1930.
[6] James, *New Phytol.*, 33, 8; 1934.
[7] Briggs, *Proc. Roy. Soc.*, B, 105, 1; 1929.
[8] Warburg and Negelein, *Biochem. Z.*, 103, 118; 1920.
[9] Harder, *Planta*, 20, 699; 1933.

Thermal Decomposition of Ozone

RECENTLY, H. J. Schumacher[1] has given his reasons for regarding the interpretation of the results obtained by me[2] as incompatible with the findings of other investigators. The essential difference between these results[2] and those of Glissmann and Schumacher[3] lies in the absolute rates of decomposition. It is possible that in the vessel employed, part of the measured decomposition was due to surface activation, the ratios of rates for the different temperatures yielding an apparent heat of activation (19,000 cal.) less than the recognised endothermic heat of reaction of the gas reaction (24,000 cal.). The 'inert gas' effects, however, both accelerating and retarding, can scarcely be related to a surface decomposition in itself, but must be gas phase processes.

The calculation of the heats of activation Q_1 (reaction $O + O_3 = 2O_2$) and Q_2 ($O + O_2 + O_2 = O_3 + O_2$) from my data was based on the assumption that the number of effective collisions was given by $Ze^{-E/RT}$, the steric collision factor being taken as unity. The values thus obtained are maximum values; correspondingly, if the heat of activation of the ternary collision is zero, the heat of activation of the secondary reaction is 9,000 cal. The correspondence between this figure and that cited by Schumacher from photochemical data (5,000 cal.) was taken as support for the oxygen atom theory, in view of the fact that the former value was calculated on principles of diffusion not involved in the photochemical decomposition.

The region in which the postulated diffusion effect can be experimentally realised is a small one, determined by temperature as well as by pressure and vessel dimensions. The interpretation of the present results is not regarded as incompatible with the photochemical decomposition from this point of view.

It appears from the summary of Schumacher[4] that the possibility of reaction chains involving excited oxygen molecules depends largely on the nature of the oxygen atom, in the sense that the excited oxygen atom produced by photo-dissociation of ozone by light of short wave-length is more likely to start a chain than is the normal unexcited atom. When the heat of activation is close to the endothermic heat of reaction, one cannot deduce with certainty that a chain mechanism must play a large part in the thermal decomposition. Since my experiments were carried out with pressures of ozone not greater than 100 mm., and for the most part in the presence of nitrogen which would presumably tend to deactivate excited oxygen molecules, the possibility of reaction chains playing a prominent part in the decomposition in such circumstances is regarded as a small one.

MOWBRAY RITCHIE.

Department of Chemistry,
University,
Edinburgh.

[1] *Proc. Roy. Soc.*, A, 150, 220; 1935.
[2] *Proc. Roy. Soc.*, A, 146, 848; 1934.
[3] *Z. phys. Chem.*, B, 21, 323; 1933.
[4] *J.A.C.S.*, 52, 2377; 1930.

The Free n-Propyl Radical

THE clean fission of the lower aliphatic ketones effected by ultra-violet light led us to examine the symmetrical di-n-propyl ketone with the object of preparing the n-propyl radical.

We allowed the ketone to stream through a transparent silica tube, and irradiated it over a restricted area with the unfiltered light from two quartz mercury vapour arcs. Free radicals were produced, and rapidly removed metallic mirrors situated 10 cm. from the nearer edge of the illuminated zone.

The volatile products resulting from the action of the radicals on mercury were passed into mercuric bromide, the excess of ketone distilled off, and the solids subjected to fractional sublimation in a vacuum. The three head fractions melted at 137°–138° (mercury n-propyl bromide, m.p. 138°)[1]. The melting point of the fourth fraction was not depressed by admixture with an authentic specimen of mercury n-propyl bromide.

It is thus concluded that di-n-propyl ketone is decomposed in ultra-violet light with the formation of free n-propyl radicals.

T. G. PEARSON.
R. H. PURCELL.

Imperial College of Science
and Technology,
London, S.W.7.
June 27.

[1] Goddard, *J. Chem. Soc.*, 123, 1168; 1923.

Units and Symbols

THIS letter is intended to be provocative. A volt (or ampere) is denoted V (or A): a millivolt (or milliampere) mV (or mA): a microvolt (or microampere) μV (or μA). A farad is known as F, a microfarad as μF (though misguided people write it mfd. or mF., which, if anything, should mean millifarad): a micromicrofarad (10^{-12} farad) is μμF. A millihenry is mH, a microhenry μH. A gram is g., a milligram is mg., but some (and not the least worthy) biochemists use a symbol which few others understand, and call a microgram not μg. but γ. A second (of time) has the symbol sec. (not ″): a millisecond is msec.: a microsecond is μsec. Why do physiologists (and they alone) persist in using the symbol σ to represent, not—as it might less unsuitably do in view of μ and γ—a microsecond, but a millisecond? And why are they permitted, instead of writing 7 msec. (which others could understand) to use 7σ, or 7 sigmas (in America) or 7 sigmata (in Oxford)?

A metre (not meter) is m. (m means milli): a millimetre is mm.: a micrometre (not micrometer!) is μm., a micron or by courtesy μ. A millimicron therefore is mμ, a micromicron is μμ. It is all quite simple, yet otherwise law-abiding people (physicists this time, who ought to know better, not physiologists or biochemists) call a millimicron a μμ (see E. N. da C. A., "Encyclopaedia Britannica", 14th edition, Vol. 18, p. 874) or apply the same symbol to the same thing, now called a "micromillimetre" (Vol. 17, p. 877) which, with this name, is clearly not μμ but μmm. Fortunately milli- and microwatts mean what they say: but 1,000 millibars amount (nearly) to atmospheric pressure, which some people (chemists this time!) insist on calling a 'megabar' (compare megohm, megacycle) because they say that a bar is 1 dyne per sq. cm. Calories (at the beginning of a sentence, or in books on nutrition) may mean either Calories (10^3 cal.) or calories (cal.): it would be just as simple to refer to kilocalories (kcal.) as it is to kilograms (kg.) or kilocycles.

The moral is clear. Let us use our symbols logically and consistently and not make other people's tasks more difficult by inventing pet-names of our own. How can nations be expected to settle their differences, even as to the dates of Summer Time, when we men of science cannot agree on μμ, or bar, or μF, and insist on hiding our meaning by σ's and γ's which are unintelligible to the majority?

A. V. HILL.

University College,
Gower Street,
London, W.C.1.
July 22.

Should Scientific Publication be Controlled?

AFTER a delay of many years, the great work (576 pages, 67 plates) on the Caddis flies, by Cornelius Betten, has at last been published by the New York State Museum at Albany. It is reviewed by Dr. C. H. Kennedy in *Annals of the Entomological Society of America*, June 1935. The reviewer remarks: "This much needed volume has finally appeared. The reviewer saw the 'revised' manuscript at Cornell in 1915. It had been practically completed nine years before. Projects of more immediate use to the tax-payer used the Museum funds that had been planned for its publication. One new species after another was scooped by various casual students of the order. The last scoop was accomplished by one who had had the privilege of studying the manuscript and who rushed two papers through by publishing privately after the present volume was on the press."

Deplorable as was the delay, it must be admitted that the so-called casual students of the order were perfectly justified in publishing their work; that it is wholly unreasonable to expect publication on a group of insects to be halted for a quarter of a century because an important monograph has been prepared but cannot be published. When it became obvious that the publication would be indefinitely postponed, the new species should have been published separately. But what is described as the "last scoop" is in a different case. I do not know what it antedates in Betten's work, but I have seen a copy, and it is a much abbreviated summary, just sufficient to validate a number of specific names. It is printed by one of those duplicating machines, now so widely used for class work in colleges. I do not think it can be considered to be merely mimeographed; it seems to represent what must be considered printing in the sense of the rules. It is published privately, but is offered for sale, and the copy I saw, in the library of the California Academy, had been purchased.

A good many years ago, a certain entomologist, a student of parasitic Hymenoptera, printed privately a series of small papers containing descriptions of new species. These he advertised for sale in one of the scientific magazines. I bought a set, which I later divided between the U.S. National Museum and the British Museum. Apparently I was the only purchaser, and the author himself, who had in the meanwhile gone to Australia, lost his own copies, and wrote begging me to return those I had.

All zoologists and botanists are aware of the trouble caused by irregular publications, and of the controversies which have arisen as to what constitutes a publication. The rule requiring that a work must be placed on sale is ambiguous, and not always observed. Thus the splendid memoirs of the U.S. National Academy are not for sale, until they come on the second-hand market. With the newer methods of duplication, as indicated above, anyone can get out a small publication and offer it for sale, though it may not be obtainable through the usual channels, and may be almost unknown.

I have lived to see many taxonomic proposals, at first derided, eventually gain acceptance and become commonplace. I should consider it a great evil if all publication were controlled by the older men, or indeed by any particular group. But it does not seem unreasonable to suggest that certain definite channels for the publication of new taxonomic proposals should be established, and that there should be some control over the manner of these proposals, so that, sound or not, they should be intelligible. It might not be unreasonable to require that a type specimen should be deposited in some museum, where it could be examined. In short, some regulation is evidently needed, and we ought not to be so afraid of unjustifiable interference that we will not do anything. Whatever is done, should have the support of 'common sense', and not merely arbitrary rules. In addition to the matter of publication, we would commend to the International Commission another growing evil, the publication of erratic names. Great liberties have been allowed,

and I think quite properly, but there is a point when a name is so peculiar, or so badly constructed, that it almost suggests a lapse from sanity. There is surely no necessity for these aberrations.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado.
June 20.

Failure of Fourier Analysis applied to Vowel Vibrations

THE curve in Fig. 1*a* was produced by multiplying each ordinate of the curve $y = a \sin wx$ by the value or the corresponding ordinate of the curve $y = e^{-\delta x}$.

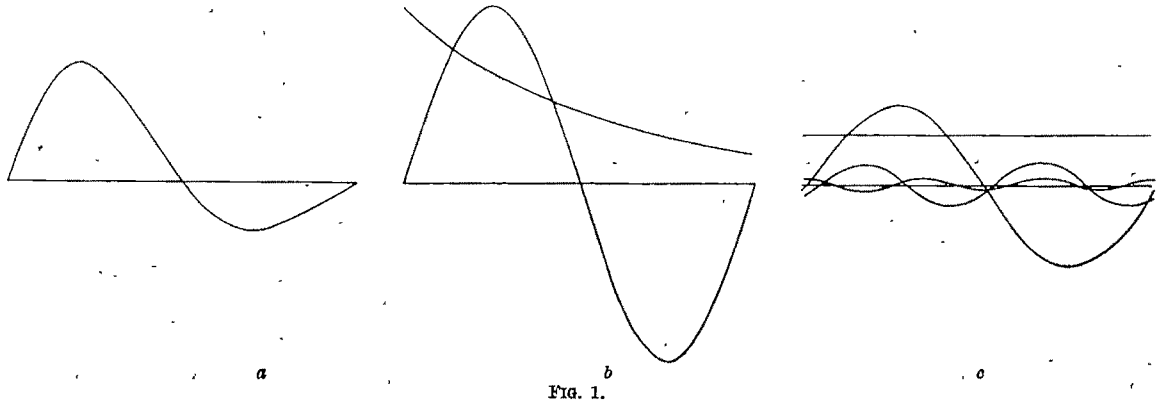

FIG. 1.

The two component curves are shown in Fig. 1*b*. The equation for the curve in Fig. 1*a* is

$$y = ae^{-\delta x} \sin (\sqrt{w^2 - \delta^2})x \qquad (1)$$

The Fourier harmonic analysis produces a constant plus a series of sine functions with pulsatances in the relations 1, 2, 3 . . . and with amplitudes that diminish from a maximum for the first one and continue in ever-decreasing amounts to infinity. The constant and the first three sine functions are shown in Fig. 1*c*. According to this analysis the equation for the curve in Fig. 1*a* would be,

$$y = A_0 + A_1 \sin (x + \theta_1) + A_2 \sin (2x + \theta_2) + A_3 \sin (3x + \theta_3) + \ldots \qquad (2)$$

As a mathematical formula, the result is perfectly correct; as an indication of the character of the curve or of how it was derived, it is a failure. It may be objected that the analysis is not intended to show how the curve was derived; the reply is that this is just what everybody who has applied it to vowel curves supposes that it does.

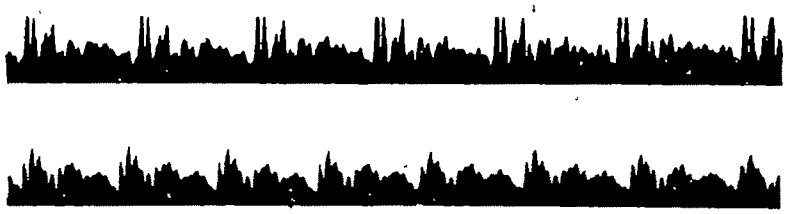

FIG. 2.

Portions of sound film tracks of *a* in *ash* and *oo* in *choo* are reproduced in Fig. 2. Each of them consists of a series of contiguous vibration bits. Each bit contains waves that begin strong and diminish rapidly to zero. The vibrations are plainly affected by strong factors of decrement. If we assume that the curve in a vibration bit is the sum of a series of sine curves, we are entitled to suppose that these sine curves have decrements and are of the character of that shown in Fig. 1*a*. A Fourier analysis, however, produces a long series of sine functions without decrements. The assumption that this indicates the manner in which the vowel vibrations were produced leads to the advocacy of the Wheatstone overtone resonance theory of the vowels, and the rejection of the Willis-Helmholtz-Hermann theory according to which a vowel consists of a series of short free vibrations. A glance at the vowel tracks in Fig. 2, however, is sufficient to show that this latter theory is the one that accords with the facts.

E. W. SCRIPTURE.

Phonetic Laboratory,
62 Leytonstone Road,
London, E.15.
June 13.

New Methods for Measuring Mechanical Stresses at Higher Frequencies

THE existing methods for measuring mechanical stresses due to vibrations are (with few exceptions, applicable only in special cases) dependent upon special devices clamped to the structure to be examined. For the purpose of measuring stresses due to impact near to the point of impact these methods are generally useless, as the measuring device then makes movements relative to the structure, so introducing errors in the stress record. These errors were examined by me in the case of two stress-recorders of the latest types and were found to be of such serious magnitudes that I had to abstain from using this kind of apparatus in my previous investigations[1].

During my stay at Trinity College, Dublin, I developed two new electrical methods, which are free from these faults.

The first is based on the change in electrical resistance in a specially prepared carbon coating which is directly applied to the surface of the structure to be tested (in the case of a metallic structure, after covering the surface first with a thin insulating layer.) If the underlying surface of such a coating

is stretched, the carbon particles move apart (and vice versa, if the structure is compressed) and so the resistance of the coating changes in the same way as the resistance of a microphone. If the coatings are properly prepared, they behave in a sufficiently stable manner and also give a linear response without hysteresis. An ordinary two-stage amplifier is required to operate a cathode ray oscillograph.

The second method uses a piezoelectric crystal (quartz or Rochelle salt), cemented to the surface of the structure to be examined. If the structure is stretched or compressed, the crystal must follow this deformation proportionally and liberates therefore corresponding charges. If a Rochelle salt crystal is used, a small crystal of a few millimetres dimensions is sufficient to operate a cathode ray oscillograph without the use of any amplifier (it may indeed be necessary to reduce the generated voltage by shunting the crossplates of the oscillograph by an additional capacity). The response of the Rochelle salt crystal has so far been found to be linear and without hysteresis, and it appears that for general purposes no necessity for the use of quartz crystals exists.

The new methods are in every way suitable for the study of impact problems. The second method has the additional advantage that, owing to the minute size of the crystal, it is possible to measure the local value of stress instead of an averaged value. A more detailed account of these investigations will be published shortly.

A. BLOCH.

Physics Department,
Trinity College,
Dublin.
June 26.

[1] A. Bloch, Zur Mechanik des Hemmschuh—Stosses und verwandter Vorgänge des Eisenbahnbetriebes. (Dissertation, Technische Hochschule, München. 1933.)

Graphical Representation of Complex Numbers

A SEARCH of the older texts has revealed an error in the analytical treatment of the graphical representation of complex numbers by Wessel in his original memoir on the subject to the Royal Academy of Denmark in 1797. The error has been perpetuated by many subsequent writers. Wessel, in proposing the representation which we now use, refers explicitly to 'operations' on right lines, and he represents any line, algebraically, by the expression $(a + eb)$, where $+ 1$ is the unit vector in a given direction and $+ e$ a unit vector in a direction inclined to that of the $+ 1$ vector at an angle of 90°. The $+ 1$ does not appear explicitly in his analysis.

Wessel goes on to consider the product of 'two right lines'. He says*: "It shall be possible in every case to form the product of two right lines from one of its factors in the same manner as the other factor is formed from the positive or absolute unit set equal to unity". Although written so long ago, this statement describes the present-day conception of the complex number as a *vector operator*.

The product is written by Wessel as follows:

$$(c + ed)\,(a + eb) = ac - bd + e(ad + bc)$$

which is a form to be found in most textbooks. Unfortunately, it contains a serious inconsistency of symbolism. As indicated above, the expression $(a + eb)$, when it appears alone, should be written, strictly, as $(a.1 + b.e)$. Now, the product form, $(c + ed)\,(a + eb)$ or $(c.1 + d.e)\,(a.1 + b.e)$, cannot be interpreted according to the rule just quoted from Wessel, unless we agree to give the symbols $+ 1$ and $+ e$ *operational* interpretations where they occur in the first, or (c,d), factor, and the original unit vector interpretations in the second, or (a,b), factor.

The inconsistency is easily avoided, of course. Let $+ 1$ and $+ e$ have the unit vector interpretations assigned by Wessel, and let any right line (or vector) be written $(a.1 + b.e)$, where a and b are numerics. Without loss of generality we may assume $+ 1$ and $+ e$ to be equal in magnitude. Now, let us put $e = j1$, where the j (or i, if preferred)† is a *rotational operator* that rotates the vector, to which it is applied, through an angle of 90° in the positive direction of rotation.

We may now write:

$$(a.1 + b.e) = (a + jb)1.$$

The expression $(a + jb)$ is a vector operator. It has a dynamic meaning precisely similar to the dynamic meaning of the ordinary number when used as a vector operator with a vector in a uni-dimensional world. In the product form, we write:

$$(c + jd)\,(a + jb)1 = [ac - bd + j(ad + bc)]1$$

and we interpret this, according to the rule given by Wessel, as follows: the operator $(c + jd)$ does to the vector $(a + jb)1$ what the operator $(a + jb)$ does to the unit vector, $+ 1$. The rule is easily justified from the definition of j and by the acceptance of the symbolic representation employed above; j is then identified with the number $\sqrt{-1}$.

In practice, the unit vector is omitted from most textbooks, and the expression $(a + jb)$ is called a vector. Herein lies a stumbling-block for many students who are not mathematical specialists—and, perhaps, for some who are!

The error does, in fact, amount to a serious inconsistency in nomenclature and symbolism, and attention is directed to it in the hope that textbook writers may help to clarify the position in future editions of their books.

W. F. FLOYD.

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London, W.C.1.
July 3.

* From the translation of the original paper given in D. E. Smith's "Source Book of Mathematics".

† Were it not for the present use of i by mathematicians, it would be better, in the following expressions, to use i as an 'identity' operator, and so write $(a + jb)$ as $(ia + jb)$ or $(ai + bj)$.

Photographs of Bright Meteor Trail of March 24, 1935

ON Sunday, March 24, 1935, between 19.05 and 19.30 G.M.T. a bright meteor trail was seen from the greater part of Holland in a north-westerly direction.

According to some observers, the trail was formed by a very luminous fire-ball, falling nearly perpendicularly to the earth. In about five minutes the white trail assumed strange forms, showing in this manner great differences in wind velocity in the higher levels of the atmosphere.

Mr. van Stralen, at Grouw (Frisia), had the good fortune to photograph this phenomenon, and we are glad to be able to give here (Fig. 1) an enlarged

reproduction of his very rare photograph (19.10 G.M.T.; exposure time, 3 minutes; diaphragm $f/4{\cdot}5$; $f=14{\cdot}6$ cm.). Mr. Groenewold, at Bedum, also obtained two photographs of different phases, reproduced in Fig. 2 (*A*, between 19.00 and 19.05 G.M.T., *B*, between 19.10 and 19.15 G.M.T.; magnification, 10; exposure 20 seconds; diaphragm $f/6{\cdot}3$; $f=10$ cm.).

From the *Astronomische Nachrichten* we learn that the phenomena was also seen in north-west Germany,

FIG. 1. Meteor trail of March 24, 1935, photographed by Mr. van Stralen at Grouw.

and Prof. C. Størmer (Oslo) informed us that he received very many observations from Denmark and Norway.

Mr. van Stralen's photograph, and some exact observations from other places, have enabled us to calculate the approximate position of the trail.

For Grouw (53° 5′ N., 50° 49′ E.) the azimuthal direction of the most luminous part was N. 60° 59′ ± 9′.W. The distance from Grouw is about 500–520 km., which gives a position over the North Sea, near

A *B*

FIG. 2. Meteor trail of March 24, 1935, photographed by Mr. Groenewold at Bedum.

the coast of southern Scotland. The height above sea-level of the luminous part must have been 70–75 km. as deduced from the photograph, and from the time at which the light of the trail disappeared, being the moment of sunset for the reflecting particles high up in the atmosphere. Low and medium clouds did not permit any observation in the British Isles. Also the illumination of the sky was perhaps too great.

The movement of the trail was apparently very slow; from some observations we deduce that the wind direction in this high layer must have been from the east.

W. BLEEKER.

Koninklijk Nederlandsch
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De Bilt, Holland.
July 5.

Ventilation and Domestic Heating

IN a note on domestic heating (NATURE, July 6, p. 16) it is said, "We do not agree with Prof. Bone that a chimney is necessary for the suitable ventilation of bed and living rooms", and add, "Many systems for ventilating rooms have been devised". Now, the nature of the radiations which are used to heat a room have been shown to be of much importance. Dark and dull red heat, in the absence of cool moving air, give stuffy feelings and by congesting the nasal membrane lessen the air-way, as proved by me and confirmed by Dr. W. A. R. Thomson, and by Dr. Dishoeck of Groningen, while bright sources have the opposite effect in about 50 per cent of those observed.

Some people are very sensitive to the quality of radiations, detest dark and dull red sources of heat, and feel a need for open air. It is necessary then that in rooms where electric heating is installed the ventilation should not be just left to an air brick as in the case of some flats now being built for those who are poorly off. Moreover, the air brick may be stopped up, and the electric heater replaced by an oil stove, and the tenants then live in an unwholesome atmosphere. We know that with insufficient ventilation 'droplet' infection becomes much greater. The chimney always secured an unseen ventilation, and allowed of alternative methods of heating. It is, I think, wrong to take this advantage away. We usually lose vigour in winter owing to our stuffy heated rooms, which give us the greenhouse effect in place of sun and cool air. We should not intensify the mischief; and where electric heating is used and no flues built, an efficient means of artificial ventilation would have to be added.

LEONARD HILL.

I THINK that most people prefer a cheerful glow to a dark or a dull red heat. Experiments have recently been carried out by the Department of Scientific and Industrial Research and the Medical Research Council (see *World Power*, 20, 229–304, Dec. 1933) to inquire into Sir Leonard Hill's statements on the 'nose opening' rays due to bright incandescent sources such as lamps, coal-fires and modern gas fires, and the 'nose closing' rays due to non-luminous sources. No evidence was obtained that any difference on 'nose opening' is due to the temperature of the source, either bright or dull, but 'nose-closing' rays were found with the clinical gas lamp specially recommended by Sir Leonard Hill. The conclusion is reached that nose-closing is due to rapid heating of the skin and is independent of the quality of the radiation.

I entirely agree with Sir Leonard Hill's remarks on ventilation. Unfortunately, it is not cheap, but its cost is only a fraction of what would be saved by building houses without chimneys.

THE WRITER OF THE NOTE.

Relation of *Botrytis* spp. to the 'Chocolate Spot' Disease of Beans (*Vicia Faba*)

IN view of the considerable losses in bean crops sustained by farmers in parts of England and Wales during the present season, it appears expedient to summarise the present position of our knowledge of 'chocolate spot' disease.

Chocolate spot disease may attack both broad and field beans, and is characterised by the appearance of chocolate brown lesions on the shoot system. Sardina[1] has described two diseases of beans in Spain which he attributed to distinct species of *Botrytis*. One of these diseases is probably identical with 'chocolate spot'. Ikata[2] considers that *Botrytis Fabæ*, Ikata, is responsible for the disease in Japan. Nattrass[3] has just reported that a species of *Botrytis* is responsible for the disease in Cyprus.

Work has been carried out on all aspects of this disease at Cambridge since 1931 under the direction of Mr. F. T. Brooks. As early as April 1933, experiments carried out at the Cambridge Botany School showed conclusively that several forms of *Botrytis* are responsible for the major part of the disease in Britain, but full publication of the results of these investigations will be delayed.

In the field the disease may assume two forms: (1) a lethal attack resulting in blackening and death of a part or the whole of the shoot system, (2) a non-lethal attack resulting in 'chocolate spot'. Both types of attack have been reproduced by artificial infection in field plots.

Chocolate discoloration of bean shoots is also caused by aphis exudates and other agencies.

A. R. WILSON.

Botany School,
University of Cambridge.
July 24.

[1] J. R. Sardina, *Bol. Pat. y Entom. Agric. Madrid*, 5, 59–80; 1931.
[2] S. Ikata, Abstract in *Jap. J. Bot.*, 7, 1–2, 6; 1934.
[3] R. M. Nattrass, *Cyprus Agric. J.*, 30, 2, 57–58; 1935.

Dissociation Energy of the CO Molecule

IN the last lines of my letter in NATURE of June 29, p. 1077, I erroneously wrote $C(^1D) + O(^3P)$ instead of $C(^3P) + O(^1D)$. This, together with a typographical error, obscured the meaning of the last sentence. It should read: "The alternative possibility that it would correspond to dissociation into $C(^3P) + O(^1D)$ and that therefore $D_{CO} = 9{\cdot}105$ v.e. will be discussed in detail elsewhere."

B. ROSEN.

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Belgique.

Points from Foregoing Letters

DR. R. BROOM has discovered tooth germs in the lower jaw of a young specimen of the Platypus, which are considerably anterior to the teeth already known. They are believed to be two incisors and a canine. If this determination of the germs be correct, *Ornithorhynchus* would seem more probably to have been descended from an Ictidosaurian reptile or a Pantotherian mammal in which there are large canines, than from a Multituberculate in which the canines were early lost.

BY bombarding fluorine compounds with alpha rays, Dr. O. R. Frisch has obtained a radioactive element of long life emitting positrons. It follows the reactions of sodium and is probably Na^{22}, though from the behaviour of Cl^{34}, P^{30} and Al^{28}, Na^{22} should have a short period. A radio-element of half-period 4·4 hours, probably Sc^{43}, has also been obtained by Dr. Frisch by the action of α-particles on calcium.

The rate at which carbohydrates are formed by plants from carbon dioxide and water in the presence of light depends, according to Dr. W. O. James, upon structural considerations which affect the amount of carbon dioxide reaching the chlorophyll granules; also, the energy absorbed from the light is greater than one quantum per reacting molecule. Hence the simplifying assumptions made in some of the formulæ put forward to explain the reaction appear unjustified.

Dr. M. Ritchie gives some explanations in answer to H. J. Schumacher's criticisms of his experiments on the rate of decomposition of ozone by heat ($O_3 \rightarrow O_2 + O$) and the deductions therefrom.

Prof. A. V. Hill directs attention to divergencies in the use of symbols representing various physical magnitudes, and appeals for greater consistency in the derivation of such symbols.

Prof. E. W. Scripture gives an example showing that, by analysing a curve according to Fourier's method, one does not necessarily obtain the true components. He supplies illustrations of sound-film tracks representing vowels, the outlines of which support the Willis-Helmholz-Hermann theory of a series of short free vibrations rather than Wheatstone's theory of overtone resonance.

Two new methods for measuring the mechanical stresses due to vibrations are described by Dr. A. Bloch. One is based upon the change in electrical resistance in a specially prepared carbon coating which is directly applied to the surface under examination, and the other upon electrical changes in a crystal of quartz or Rochelle salt cemented to the structure to be examined.

W. F. Floyd directs attention to an error in the analytical treatment of the graphical representation of complex numbers by Wessel in 1797, due to inconsistency of symbolism. The error, Mr. Floyd states, is still found in many textbooks.

Dr. W. Bleeker submits two photographs taken in Holland of a 'fire-ball' which, calculations show, fell in the North Sea near the coast of southern Scotland on March 24; it was not seen in the British Isles, owing to clouds.

ERRATUM. In the penultimate and last lines of the note in NATURE of August 3, p. 187, on the communication by A. Emmerie, the phrase "constituents responsible for the Carr and Price reaction" should read "constituents which cause a reaction simulating the Carr and Price reaction".

Research Items

Further Investigations at Hoxne, Suffolk

FURTHER exploratory work at Hoxne was undertaken by Mr. J Reid Moir in 1934 on behalf of the American School of Prehistoric Research (*Bull.*, 1935, No 11). Excavations were made both on the old brickfield site and also on the recent extension of the area of exploration to Oakley Park. In both, the present investigation exposed a section showing the stratification which affords evidence of climatic change. An addition to the fauna of the brickfield area was (?) *Sus scrofa*, associated with Clacton III, and also with other mammalian remains which show no signs of a cold climate. The Oakley Park excavation opened up an impressive section, from which it was plainly evident that the uppermost and lowest deposits were laid down under intense glacial conditions, while the intervening beds were accumulated during a temperate period. These latter are, therefore, to be regarded as inter-glacial, and represent the epoch when Late Acheulian and Early Mousterian man inhabited East Anglia. The Late Acheulian and Early Mousterian floors are associated with seams of peat, of which samples have been sent to Dr. G. Erdtman, of Visby, Sweden. His report shows that the Early Mousterian floor was laid down in temperate conditions. Dr Erdtman, however, states that the most interesting fact revealed by his preliminary analysis is the presence of *Abies*, which had not previously been reported in the Quaternary deposits of Britain It represents a family which has living representatives in eastern North America, China and Japan, but in Europe is represented only by fossil species (Tertiary or earlier). *Picea* and one, or several, other species not previously found in European post-Tertiary deposits also appear. Dr Erdtman suggests a measure of caution in immediate acceptance of this evidence at its face value.

Ear Exostoses

IN a study of ear exostoses by Dr. Aleš Hrdlička (*Smithsonian Misc. Collect.*, 93, No. 6), it is pointed out that few subjects in racial pathology have received more attention than this. The term is here used to cover all bony excrescences or tumours within the external auditory canal, though these have received a number of names. The existing literature contains material of distinct anthropological value, though it is defective for certain areas, notably Africa, China, India and Malaya and less markedly the Pacific. Ear exostoses are relatively frequent among Polynesians; but taken as a whole, they are scarce among European and American whites, while among American Indians their frequency is marked. Dr Hrdlička has not only reviewed existing records, but also has added the results of a personal examination of 7,814 skulls, forming part of the Division of Physical Anthropology, United States National Museum. From this material he concludes that the abnormality is one of considerable antiquity, going back about four thousand years to XIIth Dynasty Egypt. No example has yet been found in early man or even in neolithic times. Its frequency among American Indians, however, suggests a higher antiquity than that for which there is evidence at present. The tendency to ear exostoses is probably a pan-human condition, though there is considerable local variation It does not occur among the anthropoids. The underlying process is probably not a degeneration, but a somewhat inadequate central control of the neuro-vascular system of the parts involved, with bony abnormalities as a secondary manifestation. It is suggested that in the rapid progress and differentiation which has accompanied man's astoundingly rapid evolution, the central trophic control of the external meatal region in the greatly enlarged, altered, and still altering skull has not regained the full life-long adequacy that it possessed before.

Intelligence Tests on Japanese

REPORT No. 25 of the Institute for Science of Labour, Kurasiki, Japan, is an account of a "General Intelligence Test and its Norm", by Dr. Hoken Kirihara. Four tests were used, namely, rote memory, recognition, completion and analogy, and Rybakow's figure tests. The problems were completely non-verbal, apart from the instructions, and it is hoped that they may serve as a basis for comparing racial differences in intelligence. The results from applying the tests to about 12,000 Japanese males and females, aged from 6 to 40 years, are given in this report, and certain occupational standards have been worked out. Correlating the mental ages of 230 boys and girls derived from this test with those derived from the Binet-Simon test gave a coefficient of $+ 0{\cdot}723 \pm 0{\cdot}0213$. It was found to be too difficult for children below the age of nine years. The rote memory sub-test was not reliable for children more than twelve years old. The results have shown the developmental growth of intelligence in the different phases of childhood, pre-pubescence and pubescence. The development of the female appears to be a year ahead of that of the male, to stop a year sooner, and to be corresponding up to the twelfth year, but throughout pubescence to be absolutely less than the male. This report outlines an extensive investigation.

Chinese Starling in America

ABOUT 1897 the crested myna or Chinese starling was set free in British Columbia, and although increase in numbers was slow, it became well established. By 1925 the Vancouver colony included more than 20,000 individuals, and wanderers had been found across the international boundary in Washington State (T H Scheffer and C Cottam in *U.S. Dept Agric. Tech. Bull.*, No. 467; 1935). Further distribution has been limited, partly because climatic conditions do not favour undue increase, and partly because physical barriers—mountains on the north, extensive forests in the interior, and ocean straits to west and south—check dispersal except in an easterly or south-easterly direction. The authors, having examined the food, state that the potentiality for harm of such a gregarious and omnivorous bird, which plays havoc with fruit, is high; and that consequently every precaution should be taken to check the spread of this species and to prevent its establishment in the United States. But with introductions this is often more easily planned than accomplished.

Reptiles and Amphibia of the Antilles

LESS than five years after the publication of his List of Antillean Reptiles and Amphibia, Thomas Barbour finds it necessary to compile a new one, so many additional discoveries having been made that the old list is completely out of date. The new list contains names of species and races, with, for each, a brief note upon locality or habitat (*Zoologica*, 19, No. 3, June 1935). The variety of life in these islands, which comprise the West Indian Islands, except Trinidad, Tobago and the islands off the coast of South and Central America, is astounding. Compare the 86 forms of Amphibia and 370 reptiles, the latter including 266 lizards, 98 snakes, 3 chelonians and 3 crocodiles, with the corresponding fauna of Britain as tabulated in the new Vertebrate List, 7 amphibia, 9 reptiles!

Pearl Organs in Fishes

DR. Y. OKADA notes the occurrence of bead-like organs or tubercles in certain Japanese cyprinoid fishes (Science Reports, Tokyo Bunrika Daigaku, Sect. B, No. 28; 1934), the so-called pearl organs. The occurrence of these organs is apparently well known in the nuptial males of cyprinoid fishes, and previous authors have indicated that these secondary sexual characters have some special purpose in the breeding season, possibly being used for preparing the surface of the rocks on which the eggs are laid. The pearl organs of the Japanese cyprinoid fishes develop mostly on the tip of the snout or on the side of the face, but are also often found on the fins, the ventral surface of the caudal peduncle and the posterior part of the body. The author suggests that the tubercles may serve as contact organs, holding the mating pair entangled by the roughened surfaces. The pattern and position of the organs are different in the various species and occur in *Cyprinus*, *Carassius*, *Tribolodon*, *Acheilognathus*, *Ischikauia*, *Zacco*, *Opsariichthys* and *Sarcocheilichthys*. These tubercles are so like the so-called sensory papillæ of the Gobiidæ, and the arrangement in some cases is so much the same, that there seems to be some relationship in these organs. The gobies also lay their eggs on rocks or shells, and possibly the organs have a similar function as suggested above in the clearing of surfaces preparatory to egg-laying.

Oyster Culture in Norway

A DETAILED account of oyster culture in Norway has been published by Torbjørn Gaarder and Paul Bjerkan ("Østers og østerskultur i Norge, utgitt med bidrag av Fiskeridirektoratet", Bergen, 1934). The first part of this work consists of a clear description of the anatomy of the north European oyster *Ostrea edulis* and its young, including its chemical composition, biology and the risks that it runs, including its enemies. The second part deals with oyster culture in general, and there is a special account, occupying more than half the work, on oyster culture in Norway. The natural oyster banks along the Norwegian coast are now almost empty and little used, but the natural pools more or less connected with the fjords are ideal for oyster culture. These are of two kinds, the almost closed pools for breeding and the open basins for rearing. The hydrographical conditions make them specially suitable; there is abundance of good food and they are sheltered from wind and waves. Although much has already been done, a great deal more is expected, and the present interesting paper shows what has already been accomplished and indicates the way to further progress. Good illustrations accompany the text, both photographs showing the types of pools and line drawings showing the oysters and gear.

Table-Poultry Production

THE Ministry of Agriculture and Fisheries has issued an account of experiments in table-poultry production carried out as part of the National Poultry Institute scheme begun in 1923 (Bulletin No. 91, H.M. Stationery Office. Pp. 59. 1*s*. net). The experiments dealt with the best methods of feeding and marketing table poultry and with the relative values of the breeds generally kept by commercial egg farmers. Feeding investigations showed that dry mash gave better results than wet mash (though not better than wet and dry combined) and had the further advantage of a saving in labour costs. Reduction in expenses could also be made, without reducing the bird's gain in weight or the quality of the flesh, by substituting barley meal and maize for Sussex ground oats, and by reducing the dried milk constituent by 50 per cent.

Downy Mildew of Millet

A DESCRIPTION of "Mycological and Pathological Studies on the Downy Mildew of Italian Millet" by Makoto Hiura has recently been published (*J. Fac. Agric., Hokkaido Imp. Univ.*, **36**, Part 2, March 1935). Symptoms of the disease on Italian millet (*Setaria italica*) are given in very great detail. Systemic infection from oospores in the soil produces large chlorotic spots on the leaves, which bear conidia. These either germinate directly, or produce zoospores, which bring about secondary infection and give limited yellow spots. Oospores are produced in the leaves and flowering spikes; the former are quickly shed from the plant, whilst the latter are much deformed. The causal fungus is *Sclerospora graminicola*, and the paper under review describes the size and mode of germination of the conidia, zoospores and oospores, the influence of atmospheric conditions upon their shedding and germination, the host range of the fungus, and various methods of infection. Control methods are not described, but it should not be difficult to evolve them from the detailed study here presented. Six excellent plates illustrate symptoms and characteristics of the fungus.

Irrigation of Market Garden Crops

THE practice of irrigating growing crops is very ancient, and was probably used in the Nile basin as soon as human beings commenced the art of growing plants in garden or farm. Many modern horticulturists use the water-can or hose-pipe in summer, but the provision of water for extensive outdoor crops is a new development in England. Mr. F. A. Secrett has published a very interesting paper on "Irrigation for Horticultural Market Crops" (*J. Roy. Hort. Soc.*, **60**, Part 7, July 1935), in which he describes an apparatus for irrigating four acres of ground at one time. A centrifugal pump of suitable capacity delivers water to a system of permanent mains laid on the farm. Valves are provided every 40 ft., and connexions may be made from these to the spraying lines, which are long pipes with nozzles 2 ft. apart. Water is thus made to descend upon the crop as a gentle rain. Provision is also made for aerating the water, and an ingenious arrangement

adds minute quantities of fertiliser at any predetermined rate. A crop must never be irrigated unless it shows signs of distress; heavy soil or poor ground lacking humus will not respond to the addition of extra water, and certain crops must only be watered at night. Many other practical points are given in the paper.

Refrigeration Hygrometry

THE scientific investigation of the conditions under which food of various kinds may best be kept for long periods, without deterioration in quality, has shown that for each food there is a best temperature, a best composition of the atmosphere surrounding it and a best moisture content of that atmosphere. The question of the standardisation of hygrometers for measuring the moisture content of the air in cold storage chambers has been examined at the request of the Food Investigation Board of the Department of Scientific and Industrial Research by Mr. J. H. Awbery and Dr. Ezer Griffiths, of the National Physical Laboratory, and the results of their work are published in the July issue of the *Proceedings of the Physical Society*. The indications of a wet- and dry-bulb hygrometer were compared with those of a special dew point instrument and of a gravimetric absorption apparatus, all enclosed in a large metal chamber the temperature of which could be maintained constant at 0° C. down to − 19° C., and the air within at any desired humidity. The results are embodied in a table of humidities in terms of dry-bulb temperatures 0° to − 19° C. and wet bulb depressions 0° to 4·2° C., which differs considerably at temperatures of the dry bulb below − 8° C. from those previously available.

A Novel Optical Gauge

AN interesting brochure on optical gauging and inspection has recently been published by Messrs. Adam Hilger, Ltd. In the course of the many years' experience of this firm in the manufacture of high-grade optical instruments, it is only natural that it should have developed optical methods for testing and inspection in the engineering section of its work. In addition to the various interferometric methods, required only for work of the highest precision in gauge-testing, the booklet describes a new tool termed the 'Angle Dekkor'. It consists of a sturdily made modification of the autocollimating telescope, by means of which a reflected scale image is observed at right angles to a fixed scale in the eyepiece, thus measuring the tilt of the reflector from the normal direction. The scale of the standard instrument has a range of 25′, on each side of zero, in the direction of the fixed scale, and the image scale measures a range of ± 20′ in the perpendicular direction. On both scales, each division corresponds to a tilt of one minute of arc, and a fifth of a division can be estimated without any difficulty. When the Angle Dekkor is used in conjunction with an accurate quartz or glass set-square, a pentagonal prism or a screw-pitch attachment, a very large variety of engineering gauges and other products can be quickly tested. For example, it affords a rapid means of checking the truth of the various motions in a universal milling machine and the relations of these motions to each other. The importance of this new tool lies in the fact that the order of magnitude of the errors it conveniently measures is that commonly met with in ordinary engineering practice.

Theory of the Ionosphere

H. G. BOOKER (*Proc. Roy. Soc.*, June 1) has published calculations of the behaviour of vertically propagated wireless waves in an ionised medium in which both the concentration of the ions and the chance of collision between them varies with height. The calculation is made first for the core in which the earth's magnetic field is neglected. A simple variation of ionic density and collision frequency is assumed and it is shown that waves below a certain frequency are not reflected. As the frequency is raised from the critical value the strength of the reflected wave rapidly increases, reflection taking place at progressively increasing height. Very long waves may be specularly reflected by a different mechanism. In the presence of the earth's field there are two characteristic waves for which the complex refractive indices are different. Two approximations are available corresponding roughly to propagation along and across the lines of force, and it is shown that these approximations cover a large number of the possible cases. For frequencies near the characteristic magneto-ionic frequency, the extraordinary wave is nearly suppressed. A region of absorption may exist below the deviating region, and the dependence of absorption on frequency for high frequencies is different according to whether the absorption takes place in this lower region or in the neighbourhood of the reflecting layer.

Yale Stellar Parallaxes

WE have received the second edition of Schlesinger's "General Catalogue of Stellar Parallaxes", published by the Yale University Observatory. The second edition contains all trigonometric, spectroscopic and dynamical parallaxes available through publication or correspondence in January 1935. The convenience of having such a catalogue is self-evident, and the practice of issuing editions as frequently as is financially practicable is obviously commendable. The main catalogue lists the star's name, R.A. and Dec. for 1900, magnitude and spectrum, parallax (both trigonometric and spectroscopic), the proper motion and the DM number. Dynamical parallaxes are found in a supplementary catalogue. Prof. Schlesinger is to be heartily congratulated on the appearance of the second edition of his Catalogue.

Greenwich Stellar Parallaxes

H.M. STATIONERY OFFICE has published the "Observations of Stellar Parallax", Vol. 2, from photographs taken and measured at the Royal Observatory, Greenwich, under the direction of Sir Frank Dyson. The Greenwich parallax programme is limited to stars north of declination + 64°, that is, to the Greenwich astrographic zone. The plates were exposed in the Thomson 26-in. photographic reflector, of focal length 22 ft. 6 in., and each star was photographed at five epochs, at least four plates being secured at each epoch. The probable error of the average parallax is estimated at 0·0085″. The publication of the present volume brings the total of Greenwich parallaxes to 516 of which Nos. 267–516 appear in the present volume. The largest parallax found so far is 0·247″, and there are 37 parallaxes which exceed 0·050″. The present volume presents tables showing the distribution of absolute magnitude with spectral type. Details of each photographic plate are given in the main table in the volume, and the parallaxes, relative to the comparison stars, are tabulated in a catalogue at the end of the volume.

Work of the Chemistry Research Board

THE report of the Chemistry Research Board* drawn up by the present director, Prof. G. T. Morgan, summarises the work carried out in the Government Chemical Research Laboratory during the first ten years of its existence, and is an impressive record of a large amount of valuable research in various fields. Much of the work has an industrial bearing, and there has been useful collaboration with several firms, members of the staffs of which have been attached to the laboratory. A list of more than a hundred published papers is given, together with particulars of some thirty patents.

The first part of the report deals with researches on the corrosion of metals, which have had reference to the mechanism of corrosion in its relation to the prevention of rusting, tarnishing and corrosion of metals in industrial use. An anodic oxidation process for aluminium, in which the metal is protected by an oxide film produced electrically, was worked out, and a means of colouring aluminium has been adopted in industry The protection of magnesium and its alloys, which are used in the aircraft, motor-boat and automobile industries, against corrosion by sea-water and motor fuels, is being studied, as well as the corrosion of locomotive boiler tubes, zinc and purified iron and steels.

The report then deals with high-pressure investigations, including the synthetic production of alcohols from carbon monoxide and hydrogen, and acetic acid from carbon monoxide and ethyl alcohol. The starting point of these syntheses is represented by materials obtainable from coal. The equipment recently constructed is designed for work at 3,000 atm. at a temperature of 200° C.

New methods of carbonising coal have led to the production of tars which differ considerably from those familiar in industry. New methods of separation have made possible the identification and classification of the components of tars produced by various methods. Certain tars contain phenolic constituents readily separable by distillation, and these, in solution in caustic soda, form a very efficient and cheap wetting-out agent for use in the textile industry, which is now marketed under the name of 'shirlacrol'. The application of high-pressure technique to coal tars has produced new compounds which have been tested for possible use in the dye industry.

A large amount of work has been done on synthetic resins, and a tough transparent resin has been obtained which resembles glass and may find application as a material for artificial dentures. Experiments with the object of making synthetic resins direct from tar oils indicate the possibility of simultaneously separating the valuable hydrocarbon oils Resins formed in this way have been used for impregnation purposes, as they prevent the growth of mildew.

Since 1931, work has been proceeding in co-operation with the British Road Tar Association for the improvement in the efficiency and quality of road tars. It has been found that light, as well as air, may be important in connexion with the life of tar applied to roads.

Several problems concerned with micro-organisms have been dealt with. A method of preparing acetone-alcohol mixtures, useful as liquid fuel and otherwise, from straws and waste vegetable matter by fermentation has been demonstrated, and other investigations in this branch include the effects of micro-organisms in the deterioration of fabrics and in tainting live fish in rivers, and the degumming of silk by lower fungi instead of acids.

The preparation and testing of synthetic drugs in co-operation with the Medical Research Council, the production of a base-exchange material for water-softening from British clays, the action of drinking water on lead, and investigations of the rarer metals are other branches of work described in the report.

* Department of Scientific and Industrial Research Report of the Chemistry Research Board for the Period ended 31st December 1934; with Historical Introduction and Report by the Director of Chemical Research. Pp. v+94. (London. H M. Stationery Office, 1935) 1s. 6d net

Conifers of the Balipara Frontier Tract, Assam

IN the *Indian Forester* of May 1935 (61, No. 5, *Civil and Military Gazette* Press, Lahore), Dr N. L Bor, of the Indian Forest Service and at present political officer, writes on "The Conifers of the Balipara Frontier Tract, Assam". As a forest officer in Assam, Dr. Bor has taken full advantage of exceptional opportunities to study the forest flora of the more unknown parts of the country; some of his best work in the almost unknown region of which he is now in charge is briefly described in the article under review. The flora of this section of the Himalaya was practically unknown up to recent times and he set to work to collect, the considerable results of his activities being now under examination at the Royal Botanic Garden, Sibpur.

The area of the Eastern Himalaya in question covers an enormous tract of country exhibiting every variety of climate from that of the sweltering plains of Assam to the arctic climate of the eternal snows. Its northern boundary is the lofty Sela Range which sweeps north-eastward from the Tibet-Bhutan border and divides the Balipara Frontier Tract from Tibet proper. It contains a number of peaks more than 21,000 feet in height. Several travellers, Bailey and Moreshead, Kingdon Ward and others, have crossed the Sela pass into Tibet, but the southern slopes to the east are unexplored.

Dr. Bor gives details of the configuration of the region, its extraordinarily variable climate, its geological features and inhabitants A study of the latter

would appear a sufficiently heavy task, for from west to east "are to be found Sherchokpas, Sherdukpen, Tembangias, Khoas, Akas, Mijis, Miri Akas, Daflas, Apa Tanangs and Miris, all differing in language, custom and dress. . . . The Western tribes are peaceful and well disposed to us. The Daflas and Apa Tanangs are, however, inclined to be truculent and it is impossible to tour in their country without an escort".

The conifers discussed in the paper are *Pinus excelsa*, *P. longifolia* (in extensive pure forests), *Abies delavayi*, in pure crops on the northern slopes of Piri, between 9,000 ft. and 10,727 ft.; its home is in Szechuan, China, this being a new record of its presence in Assam. Associated with it are species of *Rhododendron*, oak, etc.

Perhaps the most interesting of the investigations carried out are those recorded in connexion with *Pinus excelsa*. This conifer occurs in two places only —the Tenga valley in the west and the Apa Tanang country to the east, two localities which are some 150 miles apart. In the Tenga valley the climate is dry, and the tree flourishes at between 5,000 ft. and 9,000 ft. Regeneration of the *P. excelsa* is very satisfactory if protection from fire is afforded.

The most interesting information with reference to this species comes from the Apa Tanang country. Here the rainfall is much higher, the elevation being 6,000–7,000 ft. The tree reaches a great size, 150 ft. in height with a girth of 14 ft. The wood of *P. excelsa* is used largely by the Apa Tanangs as fuel and for building material.

The most striking feature of this valley is the fact that the pine grows pure on the inner slopes only of the bowl, and pine trees are not found beyond the lip. On all sides the evergreen forest is apparently encroaching upon the pine, and dead pine trees can be seen emerging high above the evergreen forest on the inner side of the lip. A meticulous search in the pure pine forest failed to reveal a single seedling, showing that the pine seed cannot germinate and develop in the present conditions. It seems as if the pine is a remnant of a very large area of pure pine which is slowly dying out. In any event, it is clear that the *Quercus-Michelia-Acer hylium* is advancing upon it and will eventually prevail. This view is confirmed by certain of the Apa Tanang's elders, who told Dr. Bor that the area under pine has decreased even within their time, and that their forefathers had come to the same conclusion as that outlined above, and had as a consequence with considerable foresight ordered the tree to be raised in plantations. Seed is broadcast on hoed ground and the area protected from fire.

In the Zhob country of the Baluchistan frontier, the Sheranis attach equal value to the *Pinus gerardiana* both for its seed and timber, and endeavour to protect these forests from fire. But Dr. Bor's account of an aboriginal tribe successfully raising plantations by the cheap measures recorded must be unique.

Broadcasting in India

THE growth of radio broadcasting during recent years has been so marked that in most of the larger European countries, in the United States of America, in Australia and in Canada, the number of registered listeners exceeds five per cent of the population. Actually, the number of licensed listeners in Great Britain and Northern Ireland at the end of 1934 amounted to about 15 per cent of the population. In India, however, with its population of more than 350 millions, the number of registered listeners is less than 12,000, or about 0·003 per cent. This fact, with many others illustrating the very elementary stage attained by radio broadcasting in India, is given in a paper by Mr. K. Sreenivasan entitled "Development of Nation-wide Radio Broadcasting in India", published in *Electrotechnics* for April 1935.

After reviewing the ideals and objects of a national broadcasting service in any country, Mr. Sreenivasan discusses the status of broadcasting in various parts of the world, illustrating the main facts with a useful table of statistical data. He then passes on to the consideration of a broadcasting scheme suitable for India to replace the three existing transmitting stations. The suggested scheme involves the installation of about five national transmitting stations and sixty regional stations, with an additional five short-wave transmitters for international long-distance broadcasting. The proposed distribution of these stations is illustrated by a map, and the scheme is considered to be adequate to serve all interests and requirements, having due regard to the various languages involved. In the matter of power allocation, each of the national transmitters would have 250 kw. in the antenna, the regional stations would vary between 25 kw. and 75 kw., while the short-wave stations would be of 50 kw. rating. This gives a total power of nearly 5,000 kw., or about one watt per square kilometre for India, as compared with the existing figure of about 2·3 watts per square kilometre for Great Britain.

With regard to the distribution of receivers, Mr. Sreenivasan considers that, owing to the low standard of living prevalent in India, particularly in rural districts, there is no satisfactory alternative to community ownership of receivers and community listening. Even so, it is estimated that some 3½ million receivers will be required as an immediate objective.

The paper then proceeds to a consideration of the outline of an organisation of an autonomous public utility type for the provision, maintenance and operation of this national broadcasting service. It is suggested that a central broadcasting council should work under a Minister of Communications, and in co-operation with a number of provincial broadcasting commissions. Further sections are devoted to proposals for financing the project and to the policy underlying the programmes to be provided. In conclusion, the author modestly expresses the hope that his paper will help to create a correct perspective of the vast problem involved in the matter of broadcasting in India, and will provoke reasoned discussion on this national question.

Studies of Nematocysts

IN a work of 700 pages (Travaux de la Station Zoologique de Wimereux, 10 and 11. Paris: Laboratoire d'évolution des êtres organisés, 1934. 125 frs. each) Robert Weill describes the results of his detailed observations on the Cnidaria with special reference to their nematocysts. His investigations have been made largely on fresh material derived from 113 species of cœlenterates.

A short historical summary is followed by a careful description of a nematocyst—an ovoid capsule with a circular opening at the narrow end closed by an operculum, and here the wall of the capsule is continuous with the tube enclosed in the capsule; the basal part of the tube is generally wider and straight, the distal part narrow and spirally coiled, and both parts of the tube have on the inner surface numerous spines inserted in groups of three. The tube is discharged through the terminal aperture and the remains of the operculum are usually demonstrable; at the same time the refringency of the capsule is lost, for its contents have been expelled. The author describes the wide variations in size of the nematocysts, from 5μ in length in some Alcyonaria to 1·12 mm. in length in the siphonophore *Halistemma*.

Weill classifies the different types of nematocysts into those with closed tube, of which there are three kinds, and those in which the tube is open at its tip, of which fourteen kinds are recognised. He discusses the question of nerve supply to the nematocyst cell and concludes provisionally that a nervous connexion is unlikely. The author is very decided that the discharge of the tube is not by its unbending, like a spring, but by its devagination, for by retarding the process the stages of extroversion can be followed under the microscope. The tube is longer and wider after discharge—it may be doubled in length—hence its wall is elastic and in the undischarged nematocyst is in a state of disequilibrium. After discussing the mechanism of discharge, the author accepts the view of Iwanzoff (1896) that the discharge is due to swelling of the contents of the capsule. Discharge can be brought about only in presence of fluid which penetrates the capsule, but what determines the endosmosis is not yet known.

The author describes his observations on the development of nematocysts, and traces the migrations of the nematocyst cells, for example, in the Lucernaridæ, from their origin in thickened ectoderm at the edge of the subumbrella to the tentacular knobs. Fully formed nematocysts appear to remain functional indefinitely. About three hundred pages are devoted to a consideration of the taxonomic value of the cnidome, that is, the ensemble of the nematocysts presented by a particular species of cœlenterate. In discussing the Gymnoblastea, considered to be an artificial and heterogeneous group, Weill considers that *Hydra* represents not a primitive but one of the most complex genera, and should be placed near the Tubulariidæ. The study of the cnidome confirms the distinction between the Milleporidæ, which are allied to Gymnoblastea, and the Stylasteridæ, which are near the Calyptoblastea. Incidentally, the author does not accept Willey's observation that the filament of a discharged nematocyst of *Millepora* can be withdrawn or retracted. In their cnidome the Scyphozoa approximate more to the Hydrozoa than to the Anthozoa. Alcyonaria have a homogeneous cnidome different from that of Zoantharia. The bearing of the cnidome on the classification of anemones and corals is discussed.

This important monograph concludes with an extensive bibliography and an index of the genera and species referred to in the work.

British Association at Dublin in 1835

THE fifth meeting of the British Association was held at Dublin during the week beginning August 10, 1835. The president was Dr. Bartholomew Lloyd (1772–1837), provost of Trinity College, Dublin, the vice-presidents, Lord Oxonantown and the Rev. William Whewell, while the local secretaries were William Rowan Hamilton (1805–1865), Astronomer Royal of Ireland, and Humphrey Lloyd (1800–1881), Erasmus Smith professor of natural and experimental philosophy. The scientific proceedings were dealt with in six sections: (I) Mathematics and Physics; (II) Chemistry and Mineralogy; (III) Geology and Geography; (IV) Zoology and Botany; (V) Anatomy and Medicine; and (VI) Statistics, to which was added during the meeting the subsection on Mechanical Science Applied to the Arts. The meeting was largely attended, and there was a great deal of entertaining. Among the most famous men of science who were present were Sedgwick, Ross, Franklin, Agassiz, Dalton, Lardner, Babbage, Murchison, Rennie, Sabine, Wheatstone, Scott Russell and Eaton Hodgkinson. During the meeting the University conferred degrees upon William Smith, Sir Thomas Brisbane, Francis Baily, Prof. Moll and M. Agassiz.

Official reports of the proceedings were communicated to the editors of the *Philosophical Magazine*, and the daily papers gave accounts of some of the meetings. Perhaps the liveliest reports of the meeting were those published in the *Athenæum* of August 15, 1835, and succeeding issues, and from these a few extracts have been taken. The first portion of the report said: "The British Association has received, as we anticipated, a great accession to its members in Dublin, though many who intended to join it have been detained by their Parliamentary duties and by the Assizes. Still so many candidates presented themselves that the local council was compelled to place some restrictions on admission and to refuse, unless under special circumstances, all

applications made after Wednesday, the 5th of August, by persons residing in Dublin. . . . The arrangements made by the reception committee were excellent. . . . Accommodations were provided for a great number of guests within the walls of the College, and arrangements made for their breakfasting and dining together in the College Hall, by which the intercourse between the members has been greatly facilitated. . . ."

On Saturday, August 8, the Examination Hall of Trinity College was crowded. "Sir John Ross, Sir John Franklin, Dr. Coulter, the recent explorer of Mexico, Dr. Dalton, Dr. Roget, Professors Babbage, Powell, Murchison and many other eminent men, were among the crowd, evidently enduring some inconvenience, that they might gratify the curiosity they had excited. . . . In the list of names of members admitted on Saturday were to be found men of every creed, sect and party—Protestant clergymen, Catholic priests, and dissenting ministers—all anxious to gain a respite from agitating controversies, and enjoy a week's repose on the neutral ground of science. Visitors streamed into Dublin by the packet boats on Monday morning but by about eleven o'clock the whole of the Sections were in working order. The General Meeting of the Association took place in the Rotunda where Dr. Lloyd delivered his address and Prof. Hamilton read a report. The last function was a farewell dinner given by the Provost and Fellows of Trinity College to the Lord Lieutenant, Lord Musgrave, and 300 of the members of the Association. Just before the dinner Lord Musgrave conferred a knighthood on Hamilton, remarking in his speech, 'This is an exercise of one of those prerogatives of royalty, of which I am here the representative, most grateful to myself—most in unison I feel assured with the wishes of that august sovereign on whose behalf I act. . . . This act does not so much confer distinction, as place the royal, and therefore national, stamp upon that distinction, which has been acquired by personal qualifications and individual executions.' . . ."

In his summing up of the meeting, the correspondent of the *Athenaeum* wrote: "The meeting of the Association is now over and before we proceed to draw up a record of its proceedings we must say a few words on the general results of the week, and the impression left on our minds. On former occasions hospitality has been shown by the residents of the place of the assemblage to the way-faring visitors, and the business has preserved the 'even tenor of its way'; but in Dublin, notwithstanding the unusual quantity and quality of the scientific communications, business has been positively perplexed by the joyousness and festivities of the occasion. . . . Setting aside the distraction of mind incidental to the crowding together so much business . . . the vast number of all classes and pretensions who have joined the Association, and flocked to its halls, cannot have but disturbed the march of the proceedings. Imagine the Rotunda—a room capable of accommodating from 1,500 to 2,000 individuals—thronged to excess on some of the hottest evenings of this hot and cometary season: the ladies flirting and fanning; the gentlemen casting one eye upon Science and another upon Beauty; and the whole (saving the reader's presence) mopping and puffing and ready to drop with exhaustion and fatigue. . . . Even in the Sections themselves, the scientific men were not left in peace; both sexes were eager to attend them; and the ladies, as they could not be in the whole at once, made the best of their case by crowding in shoals to that particular section where the business was of the most abstract and recondite character. . . . The admission of ladies at the Sectional meetings, in direct opposition to the standing rule of the Association, is so manifestly calculated to destroy the efficiency of the Society, that we trust that there will be no repetition of this impropriety".

The treasurer of the Association in his report said that the receipts of the preceding year in Edinburgh were £1,626, while in Dublin they amounted to £1,750. It was very gratifying to be able to state that grants for the advancement of science of £1,700 had been placed at the disposal of the committee in 1835.

Educational Topics and Events

CAMBRIDGE.—F. R. Parrington, of Sidney Sussex College, has been appointed University demonstrator in zoology, and Dr. R. Knox and Dr. G. P. McCullagh have been appointed University demonstrators in pathology.

The Marmaduke Shield Scholarship for 1935 has been awarded to G. W. Harris, of Emmanuel College.

The offer of the Rev. J. H. T. Perkins, to give to the University a sum for the establishment of a Michael Perkins Fund, the interest of which is to be employed in making grants to young graduates working upon the natural history of animals, has been gratefully accepted.

DR. MARGARET S. SMITH has been appointed lecturer in agricultural chemistry and physics at the Horticultural College, Swanley, Kent, and will take up her duties in September.

THE University of Durham Act, 1935, which has now received the Royal Assent, sets up the following body as the University of Durham Commissioners for making Statutes for the University and its constituent divisions and colleges: The Rev. F. H. Dudden (chairman); Countess Grey; Sir W. Ross Barker; Prof. J. H. Priestley; Mr. C. Williams; Dr. G. R. Murray; Dr. T. F. Sibly; and Dr. A. Wood. Mr. A. C. Dawes will act as Secretary to the Commissioners.

THE New South Wales Ministry of Public Instruction in its last annual report gives information on the progress of its system of correspondence teaching, a system which some authorities in America would adopt in certain sparsely populated areas. The average enrolment of pupils taught by correspondence was 5,300 in primary and 210 in secondary grades, and the system, begun fifteen years ago, is reported to be still meeting with marked success. The provision of secondary education up to the intermediate standard was a new development, the outlook of which is promising. In each section of the primary department a special class of backward pupils receive special treatment. A weekly half-hour broadcast from the correspondence school is a feature said to be much appreciated and is used for answering questions. Associated with the system are voluntary donations by the pupils, amounting up to date to more than a thousand pounds, towards certain charities for the benefit of children.

Societies and Academies

PARIS

Academy of Sciences, June 24 (*C.R.*, 200, 2129–2250). ALFRED LACROIX: The tectites of Indo-China without figured forms. These are not large drops of glass shaped by fusion in the course of their fall, but the debris of larger blocks, probably fractured by shock on striking the ground. GEORGES URBAIN, PIERRE WEISS and FÉLIX TROMBE: A new ferromagnetic metal, gadolinium. The specimen of gadolinium used was pure except for 0·7 per cent of silicon and 0·03 per cent of iron. This metal is ferromagnetic. The absolute saturation reached 253·5 C.G.S. units, that of iron being 221·7. The Curie point is 16° C. LUCIEN CAYEUX: The constitution of the Senonian phosphates of Egypt. JEAN BAPTISTE SENDERENS: The catalytic decomposition of the monobromo derivatives of fatty hydrocarbons. The alkyl bromides behave similarly to the chlorides, except that the temperatures required are higher. GEORGES DURAND-VIEL was elected a member of the Section of Geography and Navigation, in succession to the late Ernest Fournier. A. KULAKOFF: Some theorems connected with Burnside's problem ANTONIO MONTEIRO: A class of Fredholm nuclei developable in series of the principal nuclei. HENRI MINEUR: The absolute magnitude of *B* stars with emission lines. The results of the analysis show that these stars do not differ from the ordinary *B* stars from the point of view of their absolute brightness, the emission arising from the large extension of their atmospheres. MARC DE HEMPTINNE and JEAN SAVARD: The ionisation potential of the nitrogen molecule. The method of electronic shocks has been utilised and the apparatus calibrated with argon and mercury. The energy of dissociation of the molecule N_2 calculated from the results, 6·72 volts, is in good agreement with the 6·8 volts deduced by Henry by another method. NICOLAS STOYKO and RAYMOND JOUAUST: The velocity of propagation of short radio-electric waves. FRANÇOIS CROZE: The general formulæ of refraction of a light pencil. YEU KI-HENG and YEOU TA: A new method for studying the corrosion of aluminium by soda. The metal is attacked by dilute soda solution in the presence of sodium tartrate, and the reaction followed by measurements of the rotatory power. A higher accuracy can be obtained by following the rotation than by the usual loss of weight method. M. MAHMOUD GHALI: A method for measuring the velocity of fall of spheres in a viscous liquid. A photo-electric cell in conjunction with an electrical recording apparatus is used: the time can be measured to 0·001 second. ANDRÉ PIGNOT and HUBERT GAUDRY: The useful surface of the membranes of pressure regulators. LÉON ARTSIMOVITCH, IGOR KOURTSCHATOV, LÉON MICCOVSKII and PIERRE PALIBIN: Concerning the capture of slow neutrons by a nucleus. IGOR KOURTSCHATOV, LÉON NEMENOW and IVAN SELINOW: The artificial radioactivity of ruthenium bombarded by neutrons. R. GRÉGOIRE: Bragg's curve of the H-rays. A. PERRET and R. PERROT: The cryoscopy of mixtures of nitrogen peroxide and bromine. No evidence could be obtained for the existence of the compound NO_2Br. MARCUS BRUTZCUS: A method for calculating *a priori* the calorific power of a technical combustible. The method is based on the quantity of oxygen required for complete combustion. A. MICHEL and GEORGES CHAUDRON: The influence of magnetisation at a high temperature and of crystallisation on the form of thermomagnetic curves. TCHENG DA-TCHANG and LI HOUONG: The precipitation of titanium as phosphate. Determination of the correct acidity for complete precipitation of titanium as phosphate. CLÉMENT DUVAL: A new method for studying complex compounds. A modified method for the study of the migration of ions under the action of an electric field can be applied to the examination of various complex compounds. Examples of the results obtained are given. EDMOND GRILLOT: Lead acetobromide. L. DOMANGE: The action of steam on some metallic fluorides. The results of experiments with the fluorides of silver, zinc and lead are given. PAUL BRASSEUR: Study of ferric orthophosphate. Description of the preparation and properties of anhydrous $FePO_4$. HENRI MOUREU and CLÉMENT HAMBLET: The mechanism of the reaction between liquid ammonia and tantalum pentachloride. The experiments show that in $TaCl_5$ two of the atoms of chlorine are more readily removed than the remaining three. PIERRE TRUNEL: The electric moments of isobutyl, isopropyl and phenyl chlorosulphites. G. DARZENS and ANDRÉ LÉVY: A new method of synthesis of derivatives of hydrophenanthrene and phenanthrenic hydrocarbons. MARCEL GODCHOT and MAX MOUSSERON: Some derivatives of 1,methyl.2,cyclopentanone and of 1,methyl.2,cyclopentanol. GEORGES BRUHAT and LOUIS WEIL: The measurement of the rotation of the plane of polarisation in oblique crystalline refraction. ANTONIN LANQUINE: New tectonic and stratigraphical observations on the zone of folding of Aups (Var). ANDRÉ DEMAY: The alternating or simultaneous action of magmatic and dynamic phenomena in the northern Cevennes. LOUIS DANGEARD and CHARLES BATARD: The conglomerates interposed in the Brioverian schists, to the north of the Coevrons (Mayenne and Sarthe), and the nature of the cadomian movements. GILBERT MATHIEU: The tertiary faults of Vendée. MARCEL GESLIN: The influence of a current of warm water on the air and radon dissolved in a cold water. V. FROLOW: The annual component (pluviometry and hydrometry in the Argentine). ALEXANDRE DAUVILLIER: Study of the terrestrial field, of the atmospheric ionisation and of the vertical current at Scoresby Sound during the polar year. MLLE. MADELEINE FRIANT: The jugal dental type of *Pteromys xanthipes*. MLLE. MADELEINE FOURCROY: Modifications of the insertions of the rootlets in wounded roots. PIERRE POTEL and RAYMOND CHAMINADE: The oxido-reduction potential of flours. SERGE TCHAKOTINE: Physiological researches on the Protozoa made by means of the ultra-violet micropuncture. JEAN RIPERT and OLIVIER GAUDIN: The relative toxicity of pyrethrines I and II. ETIENNE WOLFF and ALBERT GINGLINGER: The characters of the intermediate sexual forms obtained experimentally in the embryo of the fowl. PAUL CRISTOL, RAYMOND SEIGNEURIN and JEAN FOURCADE: The absence of dissociation of thiourea and substituted thioureas in dilute aqueous solution.

AMSTERDAM

Royal Academy (*Proc.*, 38, No. 6, June 1935). W. H. KEESOM, J. MAZUR and J. J. MEIHUIZEN: The vapour pressures of solid krypton. Measurements between 78° and 116° K. and their comparison with the theoretical formula. W. H. KEESOM and

C. J. MATTHIJS: Measurements on thermoelectric forces from 17·5° down to 2·5° K. Extension of previous work to other alloys and lower temperatures. W. H. KEESOM and C. W. CLARK: The heat capacity of potassium chloride from 2·3° to 17° K. Measurements for the purpose of testing whether the rapid fall of the θ values for silver at lowest temperatures is due to the heat capacity of the conduction electrons. H. R. KRUYT and TRUUS KRUYT: Investigation on positive and negative carbon surfaces by adsorption of thorium B. The results indicate that OH ions form the surface of positive carbon and COOH that of negative carbon. E. DUBOIS: On the gibbon-like appearance of *Pithecanthropus erectus*. While possessing many gibbon-like characteristics, *Pithecanthropus erectus* fills the previously vacant place between the *Anthropomorphae* and man as regards cephalic coefficient. J. WOUDA: A new type of colorimeter. An apparatus which determines the re-emission of a coloured surface and automatically calculates the colour point. J. F. SCHOUTEN: Foundations of a quantitative four-colour theory (1). H. BULTHUIS: The spectrum of CO+. Rotational analysis and perturbations of the $^2\Pi \rightarrow {}^2\Sigma$ bands. C. VISSER: On the angular derivative of univalent functions (2). C. S. MEYER: Integral representation of Lommel and Struve functions (1). W. VAN TONGEREN: Chemical analysis of rocks from Pulu Berhala. Analyses of the rocks described in the next paper. J. DRUIF: On rocks from Pulu Berhala (Malakka Strait). J. OUDMAN: Food reception and transport by the leaves of *Drosera capensis*, L. The growing leaves of this insectivorous plant do not form albumen from their food. IDA LUYTEN: The periodic development of *Iris reticulata*. J. B. THOMAS: The regulation of the breathing of *Lumbricus*. Oxygen consumption of worms in atmospheres of diminishing oxygen concentration was determined for normal specimens and for worms the hæmoglobin of which had been destroyed by carbon monoxide. H. DE JONG and A. GALLINEK: On surgical catatonia. The position of the surgical brain lesions which lead to catatonia in cats was determined.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 21, No. 6, June 1935). L. GODEAUX: An observation on the rational correspondences between two algebraic surfaces. J. E. VERSCHAFFELT: The relation between the coefficients of the Ettingshausen and Nernst transverse magnetic effects. A discussion of papers of the same title by Mlle. Dupont. E. DE WILDEMAN: Adventitious buds in *Hœmanthus*. P. MORTIER: Molecular polarisation and association of ethyl alcohol in various solvents. Measurements of the dielectric constant of solutions of ethyl alcohol in benzene, carbon tetrachloride, hexane, heptane and carbon disulphide. L. MARTON: Electronic microscopy of biological objects. Description of apparatus. M. H. WUYTS and MLLE. A. LACOURT: The constitution of the thiohydrazides. These compounds can be methylated both at the α or β nitrogen atom and at the sulphur atom. A. DE WAELE: Researches on the migrations of the Cestodes (5). Study of the infection of the definite host by the hydatic larva. M. and R. BOUILLENNE: The soluble sugars in *Mercurialis Perennis*, L., (2). Nature of the soluble sugars and their respective amounts in the two sexes. P. DUSTIN: Note on the comparative histology of the splenic arterial coatings. Histological experiments to determine the function of the arterial coatings. F. CORIN: Discovery of a spilitic series and of pillow-lavas in Hesbaye.

MELBOURNE

Royal Society of Victoria, June 13. HELEN T. PATERSON: Notes on plant remains from Narracan and Darlimurla, South Gippsland. EDWIN SHERBON HILLS: A noteworthy specimen of *Spaniodon elongatus*, Pictet, from the Upper Cretaceous of Mount Lebanon, Syria. The specimen described shows the caudal half of a small fish (? *Spaniodon* fry) lying in the abdomen of a large individual of *Spaniodon elongatus*. It is argued that the small fish was swallowed by the large, and when fossilised, was lying with its anterior parts digested, in the stomach of the *Spaniodon*. The contents of part of the intestinal tube of the latter are also fossilised, and it is thought that this tube must have been relatively small and straight. The feeding habits of *Spaniodon*, as indicated by this specimen and by its large teeth, are considered to be incompatible with its taxonomic position in the *Engraulinae*.

VIENNA

Academy of Sciences, May 16. JOVAN JURIŠIĆ: Contribution to the knowledge of *Bryophyllum tubiflorum*, Harvey. WOLF JOHANNES MÜLLER and O. HERING: Theory of passivity phenomena (27). Time phenomena in anodic polarisation at smooth platinum in 2*N* sulphuric acid. In this polarisation, the pore surfaces first become coated with oxide, oxygen being evolved only at a subsequent stage. GEORG KOLLER and WALTER MAASS: A component of *Baeomyces roseus*, Pers. A lichen acid, $C_{19}H_{18}O_8$, is described. ALEXANDER KOHLER: Optical investigations on synthetic mixed members of the felspar group. FRITZ KERNER-MARILAUN: Studies on the winter temperatures in alpine zone seas of the Keuper period. ARMIN DADIEU and HANS KOPPER: Raman spectra of HSD and ND_3. The Raman spectrum of HSD consists of two lines of frequencies 1880 and 2585 cm.$^{-1}$, which correspond with those of the spectra of D_2S and H_2S respectively. The spectrum of ND_3 consists of four lines of frequencies 2341, 2399, 2500 and 1588 cm.$^{-1}$, the relative intensities being 5, 5, 3 and 0 (?). ARMIN DADIEU and WOLF ENGLER: Raman spectra of SeH_2, SeD_2 and SeDH. The spectra of SeH_2 and SeD_2 consist each of a single strong line, the frequencies being 2312 and 1665 cm.$^{-1}$ respectively. These compounds should yield at least two Raman-active frequencies, the appearance of only one being explained by a valency angle of about 90°. The two lines of the spectrum of SeDH have the frequencies 2313 and 1671 cm.$^{-1}$. KARL MAYR: The position of the first positive null points of Bessel's functions of the first type. ROBERT WILLHEIM and CHARLOTTE FRISCH: Chemistry of crab glycolysis (1). Boiled crab juice contains factors which exert a reducing action, so that they disturb oxidative reactions. OTTO KOLLER: Note on a zoological research expedition to the mountains of north-western Asia Minor. ODOMAR GUGENBERGER: Stratigraphical position of the cephalopod fauna of the Casale Mountains, Palermo. EMIL ABEL and L. BLUMENKRANZ: Oxidation of oxalic acid by iodic acid when the stationary condition of the intermediate product is disturbed. ALEXANDER ROLLETT, NIKOLAUS KUNZELMANN and MAGDA BALOG: Investigations on azo dyes.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, August 11

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. J. Smart: "Insects".*

NATIONAL RADIO EXHIBITION, at Olympia, August 14–24.

Official Publications Received

Great Britain and Ireland

Forestry Commission. Fifteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1934. Pp. 102+6 plates. (London: H.M. Stationery Office.) 2*s*. net.

The Academic Assistance Council. Second Annual Report, 20th July 1935. Pp 14. (London: Academic Assistance Council.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1600: Combined Index to the Technical Reports of the Advisory Committee on Aeronautics 1909–10 to 1918–19. Compiled by H J. Sayers and G. B. Wardle Pp. 162. 8*s*. net. No. 1645: Report on Puss Moth Accidents. By the Accidents Investigation Sub-Committee. Pp. 32+15 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

The Royal Society for the Protection of Birds. Forty-fourth Annual Report (January 1st to December 31st, 1934), with Proceedings of Annual Meeting, 1935. Pp. 54. (London: Royal Society for the Protection of Birds.)

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 17. (Leeds: The University.)

London Museum Catalogues. No. 1: London and the Vikings. Pp. 55+10 plates. 1*s*. net. No. 3. London in Roman Times. Pp. 211+61 plates. Paper, 2*s* net; cloth, 2*s*. 6*d*. net No. 6: London and the Saxons. By R. E. M. Wheeler. Pp. 201+21 plates. 1*s*. 6*d*. net. (London: London Museum.)

Bericht uber die 11 Versammlung der Internationalen Foderation Eugenischer Organisationen, Konferenzsatzungen vom 18 bis 21 Juli 1934 im Waldhaus Dolder, Zurich, Schweiz. Pp 84. (London: International Federation of Eugenic Organisations.)

British Standards Institution. British Standard Specification for Laboratory Incubator, Water Bath and Oven Thermometers. (No. 619–1935.) Pp. 10. (London: British Standards Institution) 2*s*. net.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 9: (a) Some Interspecific Hybrids in the Genus Gossypium, (b) A Hybrid between *G. Davidsonii* and *G. Sturtii*. By A. Skovsted. Pp. 28. 2*s*. 6*d*. No. 10: (a) Homologous Genes for Anthocyanin Pigmentation in New and Old World Cottons, (b) A Third Series of Experiments with the Crinkled Dwarf Mutant *G. barbadense* L.—The Cross *barbadense* crinkled × *hirsutum* crinkled, (c) The Inheritance of Brown Lint in New World Cottons. By S. C. Harland. Pp. 30. 2*s*. 6*d*. (London: Empire Cotton Growing Corporation.)

First Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 4957.) Pp. viii+106. (London: H.M. Stationery Office.) 2*s*. net.

Economic Advisory Council. East Africa Sub-Committee of the Tsetse Fly Committee: Report. (Cmd. 4951) Pp. 56. (London: H.M. Stationery Office.) 1*s*. net.

The Animal Year Book. Vol. 3. Pp. vi+182+8 plates. (London: University of London Animal Welfare Society.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1624 (T 3451): Tests on Models of Armstrong Whitworth Four-engined Monoplane. By W. L. Cowley, Dr. R. Warden and G. A. McMillan. Pp. 13+4 plates. 9*d*. net. No. 1630 (T. 3448–3551): Abstract—An Application of Matrices to Oscillation Problems. By Dr. W. J. Duncan and A. R. Collar. Pp. 5. 4*d*. net. No. 1631 (S. and C. 598): Forces and Moments on a "Puss Moth" Model. By A. S. Batson. Pp. 5+16 plates. 6*d*. net. No. 1643 (Strut. 201): Approximate Method of Determining Aerodynamic Loading on Wings of Monoplane. By A. G. Pugsley. Pp. 8+5 plates. 6*d*. net. No. 1646 (S. 143, 164): Hydrodynamic Forces and Moments on a Simple Planing Surface and on a Flying Boat Hull. By W. G. A. Perring and L. Johnston. Pp. 23+21 plates. 1*s*. 6*d*. net. (London: H.M. Stationery Office.)

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1934 May 1—1935 April 30. Pp. 4. (Cambridge: Observatory.)

Medical Research Council. Fifteenth Annual Report of the Industrial Health Research Board to 30th June 1935. Pp. ii+38. (London. H.M. Stationery Office) 9*d*. net.

Technical College, Bradford. Diploma and Special Day Courses, Session 1935–1936. Pp. 246+20 plates. (Bradford: Technical College.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1632 (T. 3564): Steady Flow in the Boundary Layer near the Surface of a Cylinder in a Stream. By L. Howarth. Pp. 56+6 plates. 2*s*. 6*d*. net. No. 1634 (F M. 163): Flow Induced by Jet of Air. By Dr. H. C. H. Townend. Pp. 3+3 plates. 6*d*. net. No. 1635 (T. 3572): Tests of Aerofoils based upon R.A.F. 34 Section. By W. L. Cowley and Dr. R. Warden. Pp. 23+11 plates. 1*s*. 3*d*. net. No. 1640 (S. and C. 624): The Aileron Power of a Monoplane. By A. G. Pugsley and Dr. H. Roxbee Cox. Pp. 15+4 plates. 1*s*. net. No. 1647 (E.F. 348): The Influence of Pickling on the Fatigue Strength of Duralumin. By H. Sutton and W. J. Taylor. Pp. 4. 3*d*. net. (London: H.M. Stationery Office.)

Other Countries

Royal Observatory, Hong Kong. Magnetic Results, 1934. Prepared under the direction of C. W. Jeffries. Pp. 49. (Hong Kong: Government Printers) 1 dollar.

International Institute of Agriculture. The World Agricultural Situation in 1933–34. (World Agriculture: Conditions and Trends; Markets and Prices. Agricultural Policies and Conditions in the Different Countries.) Economic Commentary on the International Year-book of Agricultural Statistics for 1933–34. Pp. viii+503. (Rome: International Institute of Agriculture.) 25 liras.

Publicaciones de la Sociedad Geográfica Nacional. Serie B, No. 57: Las Temperaturas equivalentes en la Peninsula Ibérica. Por Dr. Walter Knoche. Pp. 16. (Madrid: Sociedad Geográfica Nacional.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 90: The Identification of the Principal Commercial Australian Timbers other than Eucalypts. By H. E. Dadswell and Audrey M. Eckersley. (Division of Forest Products: Technical Paper No. 16.) Pp. 103+27 plates. Bulletin No. 91: Further Investigations into the Transport of Bananas in Australia. By E. W. Hicks and N. E. Holmes. Pp. 35. (Melbourne: Government Printer.)

Hamburger Sternwarte in Bergedorf. Bergedorfer Spektral-Durchmusterung der 115 nordlichen Kapteynschen Eichfelder enthaltend für die Sterne bis zur 13 photographischen Grosse die Spektren nach Aufnahmen mit dem Lippert-Astrographen der Hamburger Sternwarte in Bergedorf, von A. Schwassmann; Die Grossen nach Aufnahmen des Harvard College Observatory bestimmt durch das Sterrenkundig Laboratorium Kapteyn in Groningen, von P. J. van Rhijn. Band 1: Eichfeld 1 bis 19, Deklination +90° +75° +60°. Pp. E. 31+218+2 plates. (Bergedorf: Hamburger Sternwarte.)

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 4, Nr. 3–5: Photographisch-photometrische Untersuchungen uber die atmospharische Extinktion, von Wilhelm Dieckvoss: Photographische und photovisuelle Beobachtungen von δ Cepheï-Sternen, von Hans Cox; Photographische Beobachtungen von Veranderlichen auf dem Kapteyn-Eichfeld 41, von A. A. Wachmann. Pp. 53–112. (Bergedorf: Hamburger Sternwarte)

Zoologica. Vol. 19, No. 4: The Reproductive Habits of the Common Catfish, *Ameiurus nebulosus* (Le Sueur), with a Discussion of their Significance in Ontogeny and Phylogeny. By C. M. Breder, Jr. Pp. 143–185. (New York: New York Zoological Society.)

Publications of the South African Institute for Medical Research. No. 37: The Epidemiology of Pneumonia on the Witwatersrand Goldfields and the Prevention of Pneumonia and other Allied Acute Respiratory Diseases in Native Labourers in South Africa by means of Vaccine. By Sir Spencer Lister and David Ordman With the following relative papers:—1. Prophylactic Inoculation against Pneumonia and other Acute Respiratory Diseases with Vaccine on the Randfontein Estates Mine, by P. A. Peall; 2. Pneumonia in the Native Mine Labourers of the Northern Rhodesia Copperfields with an Account of an Experiment in Pneumonia Prophylaxis by means of a Vaccine on the Roan Antelope Mine, by D. Ordman. Pp. 124. (Johannesburg: South African Institute for Medical Research.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 14, 1932. vii. Meteorologiska iakttagelser i Riksgransen, Long. 18° 8'·2 E. Gr., Lat. 68° 25'·7, Hojd over havet 508 m. Pp. ii+48. 4 00 kr. Årsbok, 16, 1934. ii. Nederborden i Sverige. Pp. ii+55. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 121: Two Notes on the Boundary Influence of Wind Tunnels of Circular Cross Section. By Itirô Tani and Masuo Taima. Pp. 47–73. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 35 sen.

Bericht uber das Geobotanischen Forschungsinstitut Rubel in Zurich fur das Jahr 1934. Von E. Rubel. Pp. 99. (Zurich: Geobotanische Forschungsinstitut Rubel.)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 69: L'Aérolithe du Hainaut; étude spectrographique. Par Prof. R. Breckpot et M. Lecompte. Pp. 31+2 plates. (Bruxelles: Musée Royal d'Histoire Naturelle.)

Journal of the Indian Institute of Science. Vol. 18A, Part 5: The Fixed Oil from the Seeds of *Amoora rohituka* (W. and A.). By P. Ramaswami Ayyar and V. A. Patwardhan. Pp. 19–24. 10 annas. Vol 18A, Part 6: Determination of Nitrogen in Soils. Part 5: Estimation of Total Nitrogen to include Nitrates. By A. Sreenivasan. Pp. 25–38. 1.2 rupees. Vol. 18A, Part 7: Studies in the Proteins of Indian Foodstuffs. Part 6: The Globulins of the Cowpea (*Vigna catiang* Walp.). By Miss K. Bhagvai. Pp. 39–47. 14 annas Vol. 18A, Part 8. Preservation of Wood. Part 1: Treatment with Creosote-Water Emulsion. By C. Varadhan and Keshaviah Aswath Narain Rao. Pp. 49–59. 1 rupee. Vol. 18A, Part 9: Biochemistry of the Spike-Disease of *Vinca rosea* Linn. By A. V. Varadaraja Iyengar. Pp. 61–67. 10 annas. Vol. 18A, Part 10: Studies in Tantalum and Niobium. Part 1: Analysis of Mixtures of Pentoxides of Niobium and Tantalum. By K. R. Krishnaswami and D. Suryanarayana Murthi. Pp. 69–73. 8 annas. (Bangalore: Indian Institute of Science.)

Tanganyika Territory: Geological Survey Department. Bulletin No. 8: The Eastern Lupa Goldfield. By Dr. E. O. Teale, assisted by N. W. Eades; with Petrological Notes by F. Oates. Pp. 61. (Dar es Salaam. Government Printer.) 5*s*.

Kaiser-Wilhelm Gesellschaft zur Forderung der Wissenschaften. Pp. 36. (Berlin: Kaiser-Wilhelm Gesellschaft zur Forderung der Wissenschaften.)

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1934. Pp. 52+2 plates. (Calcutta. Government of India Press)

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. Pp. 56. (Washington, D.C.: Carnegie Institution.)

Catalogues

Modern Books in All Classes of Literature offered at Greatly Reduced Prices. (No. 475.) Pp. 24. (Cambridge: Bowes and Bowes.)

The Story of Sillimanite Laboratory Ware. Pp. 32. (London: W. Edwards and Co.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3433 SATURDAY, AUGUST 17, 1935 Vol. 136

Organisation of Industry

THE object of industry is to make commodities for the people: one reason for organising industry is to make more commodities at a lower price so as to raise the standard of living. This is the primary purpose for which industry exists, though necessarily every firm must carry out its operations at a profit, otherwise it cannot continue to operate when its resources have been expended. The profit is claimed by capital as a reward for the risks incidental to participating in business: if there were no such reward, there would be no incentive to invest in other than gilt-edged securities. Wages and salaries are paid as part of the cost of production; they do not depend directly on profits, though in bad times the weekly wage-earner suffers lack of employment. A large school of modern thought seeks to make labour a more active partner in every manufacturing enterprise and would limit the reward to capital. In theory the idea is excellent, and where profits are good and more or less regular so that new capital is easy to obtain, its introduction into actual practice is attended with success. There are, however, industries and enterprises which are liable to fluctuations and therefore contain a considerable element of risk. These are difficult to finance, provide precarious employment and often no dividends; in them the risks and the misfortunes have to be borne by capital and labour alike; there is hardship to both.

When such industries are of the magnitude of the iron and steel or the cotton industry, the hardship is widespread, whilst the numbers of the workless or partially employed or lowly paid give them a political influence to express their grievances which tends to obscure the real nature of the problem and the steps which must be taken to solve it, always regarding the problem from a scientific angle as influenced by, and depending for its solution on, ascertainable facts and circumstances.

It is to the credit of the present Government that much of the real revival which has taken place in industry is based on the removal of difficulties of one kind and another by sound and non-political methods, sometimes by means of tariff protection or by other form of Government assistance, at other times by financial assistance in the form of refinancing with cheap money.

The need for industrial reorganisation to meet the changing problems of the day is an obvious one. Various schemes for doing this have been put forward; some of them are of a drastic character, among which may be included those involving nationalisation.

It must be realised, though the fact is not always stated, that the ultimate prosperity of any particular firm depends on the individuals who manage it, and though they cannot rise superior to the bigger economic difficulties caused by world happenings, they can do much to mitigate the incidence of these. Too much importance may be attached to machinery and too little to leadership.

If it be granted that national prosperity depends on the level of industry, then to maintain this at a high level requires the elimination of the upsets caused by alternate booms and depressions. It is agreed that these ought to be preventable and that industry requires organising with this end in view. Whilst fair competition within an industry is essential, it should be possible in certain circumstances for an industry to act as a whole, either in relation to other home industries or when negotiating with the competitive industry in foreign countries. The subjects which concern an industry as a whole are numerous; they

include research, propaganda, co-operative selling and buying, the collection of information and statistics, relations with labour, training, and more particularly the relations with our own Government in its many branches.

Such combination is effected by trade associations which, as experience is gained, are becoming more efficient, more comprehensive, more powerful and of greater use to their members and to the State. They have been developed alongside the changing conditions in industry. It is impossible to anticipate the changes or to provide for them, for they follow no rules: the more alert industries, which incidentally are those which are most scientific, are able to organise the most closely in point of time to the altered conditions.

It is essential that such organisations are entirely free from political partisanship and based only on strict economic considerations, and the same applies to the central organisation, the Federation of British Industries, which embraces all the separate trade associations as well as individual firms in its membership. Primarily formed to deal with questions of common interest presented by various Government departments during and after the War, the sphere of influence and utility of the Federation continues to increase, and it presents an organisation in advance of anything existing abroad.

Trade associations are purely voluntary, both in regard to membership and the decisions taken as the result of a majority vote. Recently the question has been widely ventilated, partly on the initiative of Lord Melchett, as to whether compulsory powers should be given to them through Order in Council, on the supposition that a full measure of industrial co-operation cannot be obtained through voluntary effort.

The compulsion of minorities is a principle which is so largely alien to British ideas that considerable attention has been given to the Bill introduced by Lord Melchett in the House of Lords. An influential committee was appointed by the Federation of British Industries to ascertain the views of trade associations and report the considered opinion of collective industry: this has been largely used in compiling the publication before us.* On this particular point it is stated by the F.B.I. Committee that the procedure of putting into force by Order in Council the decisions of the majority of an industry, when approved by an appointed tribunal and by the President of the Board of Trade, would be an undesirable addition to bureaucratic powers.

It is essential that Parliament should appreciate, as it has generally failed to do in the past, that our whole national structure is dependent on industry, and that it must assist industry to maintain its efficiency. At bottom, industry must be financially sound, working at a profit, well and scientifically managed; redundancy, overlapping and waste must be eliminated. Though it would be tempting to have powers within an industry to force the scrapping of certain plant or prevent the extension of another factory where sufficient manufacturing capacity already existed, it is widely felt that the undue extension of compulsory methods would endanger the freedom of thought and action which we enjoy to-day.

Generally speaking, voluntary methods are proving successful; and although progress by such means is often slow, it can be speeded up very rapidly and without formalities when action is agreed. Compulsion by a majority introduces the effect of rigidity and would have a cramping effect on leadership. Indeed minorities, when progressive, are often in advance of general opinion and responsible for the new inventions and methods which bring prosperity.

There have been, of course, instances in which the failure of a trade to agree has brought increasing distress to workers and shareholders alike. The F.B.I. Committee, whilst emphasising their rarity, admits the necessity of dealing with these from without, and suggests a procedure involving examination by a tribunal appointed by the president of the Board of Trade. Lord Melchett, in favouring the appointment of such statutory committees, cites the success of the Tariff Advisory Committee and considers they would enable highly specialised industrial and technical problems to be dealt with by impartial and experienced individuals.

The Report, the consideration given to the question by the individual trade associations, the addresses given by Lord Melchett to various bodies, and those given by others who take an opposite view, have served to focus attention not only on what is a relatively minor point of compulsion versus voluntary co-operation, but also on the need for organisation within an industry. The importance and the value of co-operative effort have been emphasised in no uncertain manner, and the realisation that the firms in each and every industry must act nationally for the

* Survey of Britain's Recent Commercial Policy. Pp. 50. (Federation of British Industries, 21 Tothill Street, London, S.W.1.) 1s.

good of all rather than individually for the profit of the moment is proceeding apace. Instances multiply where several firms co-operate to make a new product instead of each setting up individually in competition; there is evidence that British industry is solving the new problems of the day: hence perhaps our trade revival, our recovery of such export markets as exist in spite of exchange and similar restrictions. It remains as the next step to carry this spirit of co-operation out into the Empire, to build on the foundations of amity laid at Ottawa.

Science and Philosophy

The Frontiers of Psychology

By William McDougall. (The Contemporary Library of Psychology.) Pp. xii+235. (London: Nisbet and Co., Ltd.; Cambridge: At the University Press, 1934.) 5*s*. net.

THE need for re-examining and redefining the boundaries of these two fields of intellectual activity has been felt more and more in recent years, and may be said to have become acute with Sir James Jeans's presidential address at the Aberdeen meeting of the British Association. The incursion of the physicist into metaphysics is a new and, to the psychologist no less than the philosopher, a most striking phenomenon. Time was, not so long ago, when the right of the psychologist to be regarded as a scientific worker was challenged on the ground that his pretended science was not science at all, but metaphysics, and no one challenged more loudly or more insistently than the physicist. There is doubt whether some physicists would concede the claims of the psychologist even yet, but it is certain that they must now formulate their challenge in different terms.

Prof. W. McDougall's little book is certainly well-timed in view of the metaphysical tendencies of the new physics. Possibly the author shows a tendency to exaggerate the importance of the position of psychology. After all, psychology is a very young science. He cannot be said to exaggerate the importance of including in our scientific account of the 'mysterious universe' phenomena which fall within the field of study of the psychologist, and his deprecation of the gap that has been created between the world of the new physics and the world as experienced is at least thought-provoking. The tone of the book is controversial—at some points pugnaciously so. Possibly also the author makes rather too much of inconsistencies in the writings of well-known physicists, which are due as much to the inadequacies of our language as to the doctrines of the new physics. None the less, the book is one which required to be written, and the author has presented clearly and cogently a case that required to be presented.

Among the many interesting problems on the frontiers of psychology with which McDougall deals there are two of fundamental importance. One is the relation between science and philosophy; the other, which is really involved in the first, is the place of the conception of causality in a scientific universe of discourse.

With regard to the first of these problems, it is very doubtful whether either scientific worker or philosopher would accept McDougall's solution. According to his view, science deals with facts, philosophy with values; science aims at knowledge, philosophy at wisdom. Truth has therefore a different meaning, and the criteria of truth are different for man of science and for philosopher respectively. For the man of science, a statement or proposition is true when it corresponds to facts, and the criterion of truth is the pragmatic one, that our anticipations based on the statement should be fulfilled. The pragmatic criterion, however, has no meaning for the philosopher. As concerned with values, he seeks validity rather than truth in the scientific worker's sense.

It is true that the points of view of science and philosophy are different, and when this difference is neglected, science may become a day-dream and philosophy a nightmare. Some scientific workers of the present day—McDougall cites Needham, but there are others—seem prepared to accept the view that modern science is a figment of the mind, representing the world of concrete reality as little as a day-dream. McDougall contends, and it seems to us rightly, that such a view of science, physical or biological, is untenable, since it involves the negation of the essential principle of science itself. The philosopher, however, is scarcely likely to accept McDougall's restriction of his sphere of influence to the realm of values. On such a view, logic, ethics and æsthetics would be included in philosophy, but metaphysics would be excluded. The philosopher seeks rationality in the world of fact as well as validity in the world of value. McDougall has apparently presented us with a view of science that might satisfy the philosopher, but would not

satisfy the man of science, and a view of philosophy that might satisfy the man of science, but would not satisfy the philosopher.

The problem of the place of the conception of causality in a scientific universe of discourse is clearly one aspect of the larger problem. The notion of causality is derived from the human being's experience of his own activity and its results. McDougall argues in effect that the scientific worker's distrust of anthropomorphism has led him to an impossibly extreme rejection of anything in the nature of agency, force, power, as concepts which may be legitimately employed in the scientific description of natural phenomena. He points out that science began in the search for causes in the naïve sense of the word, and that the search for causes is still in a very real sense the life-blood of science.

If such words as truth and causality are to have different connotations in science and philosophy respectively, it can only be regarded as a grave misfortune, and McDougall's plea for reconsideration from a psychological point of view merits at least a sympathetic hearing. After all, science and philosophy are both attempts to give a consistent and rational account of human experience. The hypostatising of abstractions, with which McDougall charges physicists, has as little justification as anthropomorphism, and less than a limited and reasonable anthropomorphism. Human experience itself is a fact of the universe which any comprehensive scientific description of the universe must include.

Other fundamental problems discussed by McDougall, such as progress and value, raise the same difficulties as regards the divergence and inconsistency of scientific and philosophical points of view. One may not always agree with McDougall's conclusions, but the value of the service he has rendered in the formulation of questions of pressing urgency for both science and philosophy can scarcely be denied.

Mathematical Methods in Meteorology

Physical and Dynamical Meteorology

By Prof. David Brunt. Pp. xxii+411. (Cambridge: At the University Press, 1934.) 25*s*. net.

PROF. BRUNT'S book covers the field that links meteorology with physics. The treatment is mathematical wherever tractable problems can be defined, and elsewhere more descriptive. As a whole, the book gives an impressive review of the growing success of mathematical methods within such an empirical science as meteorology. Much of this progress is of a rather recent date and a considerable portion of it is due to the efforts of British investigators, so that it is very much to be welcomed that one of these pioneers has now found the opportunity to present the whole field of physical and dynamical meteorology in text-book form.

Let it be said at once that the book is an admirable piece of work, well arranged, sound and clear. The chapters on thermodynamics and on turbulence deserve to be mentioned especially in this connexion. They are also more complete than has hitherto been the case in meteorological works.

The following few points of criticism are less concerned with the correctness of the book's statements than with the questions of what might have been included.

The description of the heat balance of the atmosphere seems to imply that the stratosphere loses heat to space through the so-called *W*-radiation (mostly wave-lengths greater than 14μ) without having it sufficiently replenished. The theory of Albrecht (briefly referred to on p. 105, but not accepted) concerning the breaking up of the *W*-radiation band into separate lines at low temperature and pressure is the only one to my knowledge that mitigates the difficulty, in that it makes the upper troposphere the place where there is a net loss of radiative heat and where a corresponding amount of heat can be received by advection and convection.

Brunt gives a very good and up-to-date description of synoptic meteorological problems. The map illustrations are well chosen, but they would have been still more convincing if they had been based on a denser network of land stations and as many ship observations as possible. The lack of detail in the maps is, however, partly overcome by the reproduction of autographic records from selected stations, which show good examples of the various kinds of frontal passages (On p. 320, by mistake, autographic records from Valencia and Holyhead have been interchanged.)

Whereas the frontal description of the life-history of cyclones seems to have met with Brunt's approval, this is not the case with the attempt to formulate a mathematical theory of these phenomena. The reviewer agrees with Brunt in considering the waves of Helmholtz-Wegener (1921) and of V. Bjerknes (1921) as inadequate analogies to the nascent cyclones. Both of these are purely gravitational waves in horizontal surfaces of

discontinuity on a non-rotating earth. But it must be remembered that the contributions in question formed only the very first beginning of a general exploration of all possible small disturbances of an initial state of rest or of steady motion in the atmosphere. These disturbances have to begin with the character of stable or unstable waves. The stable ones remain small and unimportant, whereas the unstable ones grow larger and more intense. Unstable waves with wave-lengths as long as those observed in nascent cyclones were not found until the waves were transferred to a sloping surface of discontinuity on a rotating globe (Solberg, 1928–33). These waves, of a composite gravitational-inertial character, also show the following features: quasi-horizontal orbits of the air particles, periods longer than $12/\sin\varphi$ hours and uni-directional wave-propagation. Waves having all these properties seem to be justifiably analogous to the nascent polar front cyclones.

It is to be hoped that the wide field of atmospheric wave-motions, with its applications to tides, polar front and tropopause waves, wave-clouds and acoustics will be represented in a later edition of Brunt's book.

The reviewer's suggestions should of course not be taken as signs of severe criticism. After all, Prof. Brunt's book is in nearly all fields so masterly that it is bound to prove indispensable to all students of dynamical meteorology for many years to come. J. BJERKNES.

Kükenthal and Krumbach's Zoology

Handbuch der Zoologie:
eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (Berlin und Leipzig: Walter de Gruyter und Co., 1932–35.)
(1) Bd. 2: Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida. Lief. 15. Pp. 113–240. 16 gold marks. Lief. 16. Pp. 193–320 + xiv. 18 gold marks. Lief. 17. Pp. 241–352. 14 gold marks. Lief. 18. Pp. 161–278 + xviii.
(2) Bd. 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 4. Pp. 96. 12 gold marks. Lief. 5. Pp. 97–192. 12 gold marks. Lief. 6. Pp. 65–138 + 6. 10 gold marks. Lief. 7. Pp. 193–288. 12 gold marks. Lief. 8, Teil 1. Pp. 33–96. 8 gold marks.
(3) Bd. 4, Hälfte 2: Insecta 2. Lief. 1. Pp. 893–1036. 18 gold marks. Lief. 2. Pp. 1037–1132. 12 gold marks.
(4) Bd. 5, Hälfte 2: Tunicata. Lief. 1. Pp. 96. 12 gold marks. Lief. 2. Pp. 97–192. 12 gold marks. Lief. 3. Pp. 193–272. 10 gold marks. Lief 4. Pp. 273–400. 16 gold marks. Lief. 5. Pp. 401–544. 18 gold marks.
(5) Bd. 6, Hälfte 1: Acrania (Cephalochorda), Cyclostoma, Ichthya. Lief. 2. Pp. 113–208. 12 gold marks. Lief. 3. Pp. 209–336. 16 gold marks. Lief. 4. Pp. 337–448. 14 gold marks.
(6) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Halfte 1, Lief. 2. Pp. 129–224. 12 gold marks.
(7) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Hälfte 2, Lief. 7. Pp. 657–768. 14 gold marks. Lief. 8. Pp. 769–899 + xi. 18 gold marks.

(1) THESE four parts complete the second volume of the "Handbuch der Zoologie". The fifteenth and seventeenth, about 230 pp., are devoted to an excellent account of the Hirudinea which is commendable for its attention not only to general structure and morphology, biology and development, but also to the neurones and other details of histology. About a third of the 300 illustrations are due to the senior author, Dr. J. A. Scriban. Appended is a list of rejected names of genera and species of leeches and the corresponding names now considered to be valid.

The sixteenth part contains the concluding portion of Prof. E. Bresslau's account of the Turbellaria. Regeneration and regulation, so much studied in the triclads, ecology and geographical distribution receive full consideration. A useful list is given of parasitic Turbellaria and their hosts Prof. Bresslau and Dr. E. Reisinger have contributed a competent and well-illustrated account of the Temnocephalida.

In the eighteenth part is the excellent index to the entire volume.

This second volume, the publication of which has extended over nearly six years, is divided into two halves. The first half, which forms a volume of nearly 1,400 pages with a similar number of figures, contains the descriptions of the flatworms, Nemathelminthes, Rotifera, Gastrotricha and the Bryozoa Entoprocta. The second half is devoted to the Annelida and the Gephyrea and contains about 850 pages and 860 figures. The volume has been planned on a scale sufficient to enable the authors to deal with their respective subjects in a thoroughly adequate manner, and the result is a volume of great interest and usefulness.

(2) Of the five parts of the third volume noted above, one (the sixth) is devoted to the account of

the Onychophora (*Peripatus*) and the other four to some of the orders of Arachnida.

Dr. F. Zacher summarises present knowledge of the anatomy, geographical distribution and classification of the Onychophora and refers to some features of their biology, for example, their power of fasting and their mode of locomotion. Some reference to the histology of the alimentary canal might have been included. The paucity of our knowledge of the physiology of these animals emphasises the interest of the investigations now in progress.

The fourth, fifth and seventh parts contain accounts by Dr. A. Kästner of the Pedipalpi, Palpigradi, Ricinulei and Solifugæ (incomplete), and by Dr. Max Beier of the Pseudoscorpionidea. Both authors have given useful and adequate descriptions of the anatomy and biology of these orders and have contributed new illustrations.

Prof. Gerhardt contributes in the eighth part a useful account of the Xiphosura (*Limulus*) which, however, does not include notice of the interesting observations of Carlson and others on the physiology of the heart.

(3) Of these parts the first, by Dr. A. Handlirsch, is on the Hymenoptera and the second, by Prof. Meixner, on the Coleoptera (unfinished). The treatment of the morphology, natural history and classification of the Hymenoptera follows the usual lines. In the very brief section on physiology we do not find any information on the enzymes of the alimentary tract, on visual acuity and how bees recognise their own hive, or on the observations of von Frisch on colour vision, smell and taste in bees. Nor do we find any reference to the effects on external characters, sex and reproduction produced by the parasite *Stylops* in the Hymenoptera in which it is present, or to the occurrence of the Pupiparan *Braula* on bees.

(4) The first and second parts of the fifth volume (second half) contain a monograph of about 200 pages on the Appendiculariæ by Prof. Hans Lohmann, whose studies on these ascidians, extending over forty years and including the examination of collections from many expeditions, give him a special claim to write this account. He describes in detail the anatomy, development and biology of the members of this class and devotes a good deal of attention to the formation and structure of the 'house' of *Oikopleura*, to the ingoing and outgoing currents, and to the basket-work which forms the food-collecting mechanism. The geographical distribution and the classification (into twelve genera) are carefully considered, and in a useful diagram Prof. Lohmann represents eight stages in the probable evolution of the genera of the family Oikopleuridæ.

The third part begins with a brief general introduction to the natural history of the Thaliacea—*Pyrosoma*, *Doliolum* and *Salpa*—by Prof. G. Neumann, who has had long experience in the investigation of these floating ascidians. The emission of light by *Pyrosoma*, first seen by Péron in 1804, is discussed, and the recent work on the symbiotic bacteria in the mycetocytes in which the light is produced is carefully set forth. A detailed account of the Pyrosomida and the Cyclomyaria, in which the development and budding receive particular attention, is completed in the fourth part.

In the fifth part the last order of the Thaliacea (*Salpa* and its congeners) is well described by Prof. Ihle, who adds an appendix on the aberrant genus *Octacnemus* discovered by the *Challenger* Expedition and found only twice since then.

(5) Dr. V. Pietschmann provides, in these three parts, an account of the Cyclostomes which, however, will require at least one further part for its completion. Ninety pages, a disproportionate amount of space, are devoted to the account of the structure of the brain and spinal cord, including studies of the neurones from the work of Retzius and other neurohistologists. The numerous illustrations are well chosen and excellently reproduced.

(6) Dr. Otto von Wettstein completes his description of the anatomy of *Sphenodon*, the nervous system, sense organs, alimentary respiratory, vascular, excretory and reproductive systems being successively considered. The development is briefly sketched, the fossil relatives of *Sphenodon* are discussed, and what is known of the biology of the animal is adequately summarised.

(7) In these two parts, Prof. E. Stresemann's important volume on the birds is completed. In the first fifty pages are discussed the many aspects of migration, and examples of various kinds of migration are described. Among the examples of long flights in migration he states that it appears almost impossible that a snipe, *Capella hardwickii*, should fly without resting, twice in the year, from its breeding place in north Japan to its winter quarters in eastern Australia and Tasmania, where it lives from September until January. The distance between its two homes is 5,000 km. and the bird has never been found in any intermediate station. The work done on a shorter migration by a moderate-sized plover, *Charadrius dominicus fulvus*, flying from the Aleutian Islands to its winter quarters in the Hawaiian Islands, the shortest passage between which is 3,300 km., is represented by about a quarter of a million strokes up and down of the wings. The bird is estimated to travel 26 metres a second and to make two strokes of the wings a second over the flying period of

35 hours. Estimates for other birds give periods of pauseless flights of 40–48 hours. The reserves available in the body to meet this great demand for energy are fat, glycogen and protein, of which fat is by far the most important. Writing of the heights attained by birds, the author records that two British aviators saw two large birds, probably cranes, at a height of 15,000 ft., that a flock of rooks was once observed at 11,000 ft. and that plovers were seen at more than 5,000 ft. But, according to aviators, birds fly as a rule at a height of less than 1,000 metres and the smaller ones below 300 metres. This part of the work is of great general interest.

A list is given of the helminthes and arthropods parasitic in or upon birds and, in connexion with the Mallophaga, a brief consideration of these insects as possible indicators of the affinities of their hosts, leads to the conclusion that such a method must be applied with the greatest care and that at least one of the cases cited cannot be supported.

The classification which follows contains also notes on structure and biology, and is illustrated by drawings of skeletal and other anatomical features and by photographs of birds in Nature.

Prof. Stresemann's volume of 900 pages is a well-balanced and exceedingly interesting account of the structure and life of birds.

When the first part of this "Handbuch" was published nearly ten years ago, the work was advertised to be completed in five volumes. It has expanded to seven volumes, each of which except the first is divided into two halves. It would be of advantage to many subscribers if the editors and publishers, who are probably now within sight of the end of their labours, could give some idea when the remaining parts of the work are likely to be completed. Meantime we offer them, and the contributors of the parts above noted, cordial congratulations on the high quality of their work and on the extent of the output during the last three years.

Stainless and Chromium Steels

(1) The Book of Stainless Steels:
Corrosion resisting and Heat resisting Chromium Alloys. Edited by Ernest E. Thum. Second edition. Pp. xii+787. (Cleveland: The American Society for Steel Treating, 1935.) 5 dollars.

(2) Chromium Steels
By Dr. Richard Henry Greaves. (Department of Scientific and Industrial Research.) Pp. vi+321+4 plates. (London: H.M. Stationery Office, 1935.) 7*s*. 6*d*. net.

(1) THE introduction of steels having a high resistance to corrosion is probably the most important advance made in the metallurgy of steel in the last twenty-five years. Beginning with the invention of 'stainless' cutlery steel by Brearley, the range of composition of corrosion-resisting steels has been widened, until now products having the most diverse mechanical properties have been obtained. By using nickel and chromium together and keeping the percentage of carbon low, alloys are made which can be pressed, drawn, or otherwise worked without injury to their chemical properties. It was found, however, that exposure to high temperatures, either over long periods as in superheater tubes, or intensely for a short time as in the making of welded joints, may cause a peculiar kind of brittleness, and much research was necessary to find means of overcoming this difficulty, mainly by the addition of small quantities of other elements.

In the present work, which has soon reached a second edition, steels of this class are discussed from every point of view by a large team of authors. The manufacture, constitution, properties and uses in the engineering and chemical industries are fully discussed, and the precautions to be taken in welding and in the construction of plant are explained with great thoroughness. As is natural in such a composite work, there is some overlapping, and the contributors do not always agree on matters of detail; but in general the information proves on testing to be full and accurate. It may be mentioned that eleven pages are occupied by a list, classified according to composition, of the trade names of the 'stainless' steels, although only American brands are included.

(2) Chromium is an essential component of steels of the stainless class, but it also enters into the composition of many other steels of technical value, among them the nickel-chrome steels so widely used in engineering. The simple chromium steels, except perhaps those used for ball-bearings, are less frequently discussed, and Dr. Greaves has rendered a valuable service in presenting so detailed an account of their properties. Many of the experimental data are derived from work at the Research Department, Woolwich. The information is clearly given, and illustrated by excellent photomicrographs. Full references at the end of each section make it easy to consult the original publications.

The Fundamentals of Chemical Thermodynamics
By Dr. J. A. V. Butler. Part 1: Elementary Theory and Electrochemistry. Second edition. Pp. xv+253. (London: Macmillan and Co., Ltd., 1935.) 7*s*. 6*d*.

IN the second edition, the general plan of this book has been retained, but several chapters have been rearranged and partly rewritten. This revision has improved the utility of the book. About fifty pages of new material have also been added. These include a discussion of heterogeneous solid–gas equilibria, dealing with the carbon–oxygen reaction and its participation in the blast furnace; the methods of electrometric hydrogen ion determination and potentiometric titrations, which are very briefly dealt with; oxidation-reduction indicators, which are briefly but clearly explained; and a section on electrolysis which includes a discussion of over-voltage from the modern point of view.

It is doubtful whether the treatment of freezing point depression on p. 76 has any advantage over the usual one, in which the thermal properties of the solution are eliminated, since no proof of the validity of the second equation is given. The name 'isochore' applied to an equation for constant pressure (p. 98) seems misplaced. The author adopts the American definition of free energy and introduces the term 'net work' for its diminution, that is, the actual work minus the work done against external pressure, which seems a useful procedure. The book is clearly and accurately written, and the new edition is likely to increase its popularity and usefulness.

The Discovery of Specific and Latent Heats
By Dr. Douglas McKie and Niels H. de V. Heathcote. Pp. 155+6 plates. (London: Edward Arnold and Co., 1935.) 6*s*. net.

THIS scholarly treatise emanates from the School of History, Methods and Principles of Science at University College, London, and its authors must surely have devoted many hours of patient study and research among the original eighteenth century works in order to obtain the material for their book. As Prof. E. N. da C. Andrade, in his eulogistic preface points out, the subject of the book is no less than the very foundation of the modern science of heat. Most of the writings to which reference has been made have been consulted in the original languages, including the Swedish of Wilcke. The authors have established by these studies that his work, while independent of Black's, was "both later and less satisfactory". The credit for the discovery of specific and latent heat may therefore be fully attributed to Black.

Portraits of the leading figures are reproduced; some of the lesser-known ones have only been secured after much trouble. A valuable feature of the book is the inclusion of extracts from the originals, showing the care and trouble with which these early experiments were carried out. It has often been urged that present-day students should study the early masters, and this book provides a convenient means so far as the subject of heat is concerned. H. R. L.

Research: the Pathfinder of Science and Industry
By T. A. Boyd. Pp. xvi+319. (New York and London: D. Appleton-Century Co., Inc., 1935.) 10*s*. 6*d*. net.

IN this volume the author tells in a pleasing way just what research is, and what the ordinary research worker does. The book is divided into five parts. In the first, the distinction between pure and applied research is explained; in the second the organisation of modern research and the general lines followed are discussed, including useful sections on the financing of the projects and the selling of the results. The third and fourth sections, "Men" and "Qualifications", contain information which must prove of value not only to those responsible for appointing the staffs of laboratories but also to those anticipating scientific research as a career. Part V, "Achievement", should prove a fruitful source of replies to those who doubt the wisdom of spending time and money on research. Part VI consists of miscellaneous essays.

The reading is apt to be a little discontinuous owing to the continual introduction of anecdotes and quotations, some of which are repeated more than once. *Bons mots* uttered by certain leading American directors of research laboratories are also liberally sprinkled throughout the book. The value of these excellent essays might have been enhanced had the author included information and facts concerning present-day research in countries other than America; it would have been of value to read in such a book some of the important pronouncements of a few of the leading European directors of research, alongside those of their American contemporaries. H. R. L.

Principles of Mechanism
By Prof. C. E. Pearce. Pp. ix+283. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21*s*. 6*d*. net.

INTENDED to be used as a textbook in classes entering upon the study of mechanisms and having little familiarity with the details or operation of machinery in general, Prof. Pearce's "Principles of Mechanism" provides a useful elementary survey of the subject. The matter is much more on the practical side than the title suggests, and the arrangement is designed to lead up to the general principles through a detailed discussion of a number of the more important and representative applications such as: friction, toothed and screw gearing; belt, rope and chain drives; intermittent motions; ordinary and epicyclic wheel trains. Then, after explaining in detail and by numerous examples the method of analysis by centro or virtual centre, the author concludes with linkages, cams, and the geometrical problems involved in straight line motions, motor-car steering gears, etc.

While the book as a whole deals with matter which is not new, the author has succeeded, by his arrangement of the subject, the explanatory text and the examples chosen, in putting it before his readers attractively and convincingly. A valuable feature for the student is the comprehensive range of problems presented for solution. J. A. C.

The Rev. John Kerr, F.R.S., Inventor of the Kerr Cell

By Dr. Robert C. Gray

ONE of the many problems in television reception is that of modulating the brightness of the spot of light that, travelling very rapidly over the screen, gives the sensation of a completely moving picture. In one system a neon lamp is used, and the brightness of the lamp is varied by the incoming signals being allowed, after suitable amplification, to alter the voltage across the lamp. A neon lamp is not very bright, compared with a filament or arc lamp; and the next development was the use of a bright lamp, the brightness of the beam of light being altered after the light had left the lamp.

The first experimenters who tried this latter method found that the necessary apparatus was already available in the Kerr cell; it had been invented in 1875 by a Glasgow man, and had been lying for more than fifty years awaiting a practical application.

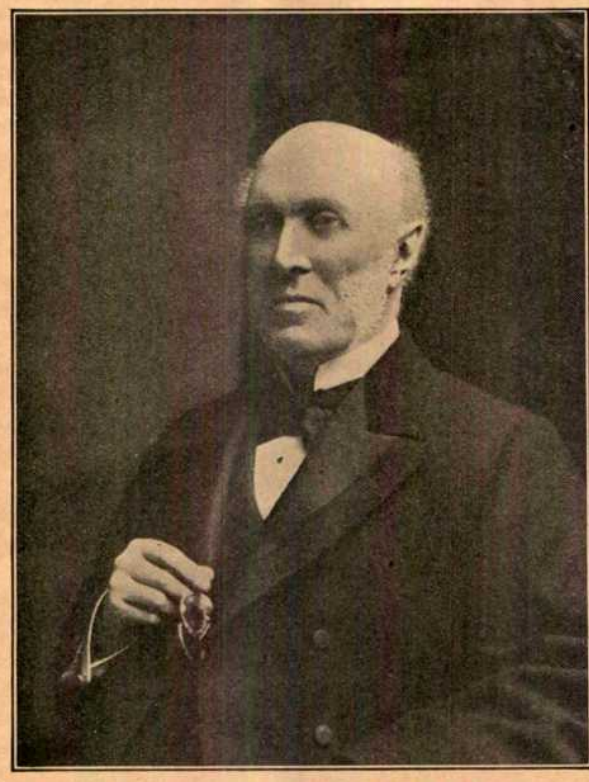

FIG. 1. The Rev. John Kerr, M.A., LL.D., F.R.S. (1824–1907).

John Kerr was born at Ardrossan, Ayrshire, on December 17, 1824. He was the second son of Thomas Kerr, who owned a fleet of fishing vessels, and he received part of his education in a village school in Skye. He entered the University of Glasgow in 1841 as a divinity student, and took the usual classes for the degree of master of arts. During the session 1845–46, he took the class of natural philosophy, when it was taught during the illness of Prof. Meikleham by David Thomson, afterwards professor of natural philosophy at Aberdeen. In 1846 William Thomson, who later became Lord Kelvin, was appointed to the chair of natural philosophy. William Thomson was only six months older than Kerr, and there sprang up a close friendship between these two young men, professor and student, each twenty-two years old, a friendship that was to last for more than sixty years until their deaths, within four months of one another, in 1907. Kerr continued his studies in physics under Thomson for three more years, gaining special prizes, in successive years, on the subjects of "The Mathematical Theory of Magnetism", "The Mathematical Theory of Electricity", and "The Distribution of Electricity on Spherical Conductors". He graduated master of arts in 1849, eight years after his first matriculation, "with Highest Distinction in Mathematics and Natural Philosophy", and was awarded the Earl of Eglinton's Prize of twenty sovereigns as the most distinguished student in mathematics and natural philosophy. He engaged in teaching for some time, and was ordained to the ministry of the Free Church of Scotland, but did not preach very often.

In 1857 Kerr was appointed lecturer in mathematics and physical science in the Free Church Training College for Teachers, Glasgow. In 1863 he published a pamphlet entitled "The Metric System: its Prospects in this Country", and in 1867 a book on what he called "Rational Mechanics". In the following year the senate of the University of Glasgow, on the recommendation of Profs. Thomson and Blackburn, conferred on Kerr the honorary degree of doctor of laws.

From 1848, Prof. Thomson was gradually converting what had been the old professorial wine-cellar into a physical laboratory for students, the first in the world. Thomson invited his students to help him in his measurements, and Kerr was one of the earliest members of the pioneer team, composed, strangely enough, mostly of divinity students. This experimental training under an

enthusiastic leader had a great influence—as such training generally has—on Kerr's after-life, and when he joined the teaching staff of the training college, he utilised a cellar there for experimental work. Afterwards he worked in the basement of his house. He was fifty-one years of age when in 1875 he made his first and most important contribution to science, by a publication, in the

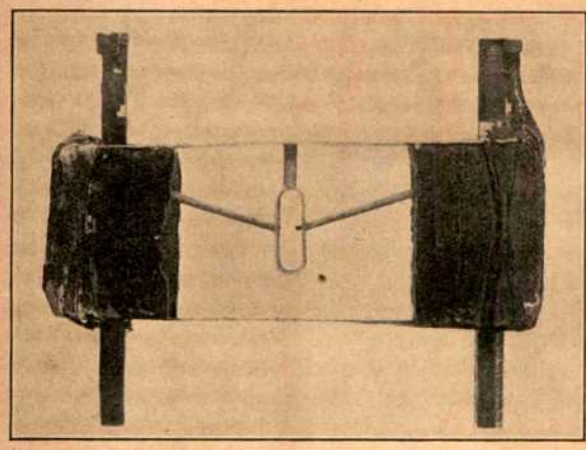

FIG. 2. The first Kerr cell, used by Dr. John Kerr in his discovery of the Kerr electro-optic effect.

Philosophical Magazine, of the discovery of what came to be known as the Kerr electro-optic effect. It is this effect that is utilised in the Kerr cell used in television reception. Faraday in 1834 thought that this effect might exist; he tried to detect it, but failed. William Thomson in 1845 suggested that it might be worth while to search for the effect; his attention was directed to Faraday's negative result, and he abandoned the idea. Thirty years later, Kerr looked for the effect, and found it, first in glass, later in certain liquids.

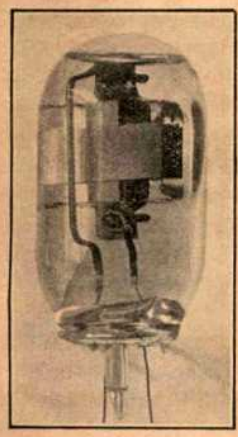

FIG. 3. Kerr cell (1935) as used by Baird Television, Ltd., in television reception.

The original piece of apparatus with which Kerr detected the effect in glass was a simple slab of glass, measuring six inches by three inches, and three quarters of an inch thick; two collinear holes, each an eighth of an inch in diameter, were drilled from the two ends, parallel to the long edges, the ends of the holes being about half an inch apart. Down each of these holes was passed a wire from one pole of an induction coil, and polarised light was passed from one face of the slab to the opposite face. When the induction coil was operated, Kerr found, as he expected, that the glass had become doubly refracting. He followed up this discovery by searching for, and finding, the same result in liquids. The original cells that he used are in the care of the University of Glasgow, and a photograph of the first cell used for liquids is reproduced as Fig. 2. For comparison, a photograph of a modern Kerr cell is also reproduced (Fig. 3). In the original Kerr cell, the cavity in the centre was closed at the sides by plates of glass, and was filled with liquid through the channel drilled from the top; wires that carried the varying electric potential will be seen passing down the sloping holes; polarised light was passed through the liquid from one side of the slab to the other. In the modern Kerr cell, the voltage is applied between two sets of alternate plates; the liquid used is nitrobenzene, and the light is passed through the liquid in a direction parallel to the planes of the plates. When in 1898 Lord Lister, president of the Royal Society, was presenting a Royal Medal to Dr. Kerr, Lord Lister said: "It has been a matter of admiration and wonder to subsequent investigators that Dr. Kerr should have been able to learn so much with the comparatively simple and ineffective apparatus at his disposal". It is related that Dr. Kerr, then seventy-four years old, was much peeved at Lister's remarks: "Simple it may be," he protested, "but not ineffective; rude, but not crude".

In 1876 the British Association met in Glasgow, and Kerr read a paper on his second discovery, the Kerr magneto-optic effect, which has been of much importance in the theory of magnetism. Altogether Kerr published, between 1875 and 1901, only ten papers, but each is of permanent value. In 1890 he was elected a fellow of the Royal Society, and in the following year Sir Arthur Rücker, speaking at the British Association, referred to Kerr's outstanding discoveries and said: "The generations which reap the harvest which earlier students of the science of electricity have sown will not forget the name of Dr. Kerr as that of a physicist who completed in the laboratory of a training college a chain of evidence of which Faraday and Maxwell had forged the first links". In 1898 the Royal Society awarded him the Royal Medal, now in the Hunterian Museum of the University of Glasgow. At the dinner that followed the presentation of medals, Sir Oliver Lodge, who had been awarded the Rumford Medal at the same time for his researches in radiation, replied for the medallists; speaking of Dr. Kerr, he said that Dr. Kerr had made two first-class discoveries in science, and his name would go down to posterity linked with these discoveries for all time; ten centuries later the Anglo-American race would know and remember the name of their medallist, John Kerr. Kerr retired from his lectureship at

the Training College in 1901 after forty-four years' service. His country recognised his work by giving him, in 1902, a Civil List pension of £100 a year. He died on August 18, 1907, three months before Lord Kelvin, in his eighty-third year.

Dr. Kerr was a well-built man, over six feet in height, of attractive and lovable personality. The late Prof. Andrew Gray wrote of him: "The name of this quiet and unostentatious teacher and experimentalist will be linked for all time with that of Faraday. He would not himself have desired any better immortality"; and Prof. Magnus Maclean, who had been a student under Kerr and is still with us, said at Kerr's retirement: "No one could have passed through Dr. Kerr's class without observing and being influenced by the singular simplicity, the sincerity and the lovableness of his character".

The Draft Poisons List and Poison Rules

The Chemical Manufacturer and the Chemist

Interpretation of the Rules

THE report of the Poisons Board together with the draft Poisons List and Poison Rules, which was discussed in NATURE of June 22, p. 1013, raises a number of questions of detail of interest to many besides the pharmacist. The more important of these questions are those which affect the chemical manufacturer particularly, and those which concern the profession of chemistry as a whole.

The first set of questions was considered at a meeting convened by the Association of British Chemical Manufacturers on July 4, which was attended by Mr. M. D. Perrins, secretary of the Poisons Board, to discuss the interpretation of the draft Poisons List and Rules. At the outset, Mr. Perrins pointed out that the only real distinction between Part I and Part II of the Poisons List, that between poisons which can be sold by retail to the general public by authorised sellers of poisons, that is, by registered pharmacists, and those which can be so sold only by listed sellers and authorised sellers of poisons, does not affect the sales with which the chemical manufacturer is concerned. The distinction between substances in the First Schedule and those which are not is, generally speaking, that those in the First Schedule have various restrictions applied to them, such as that the purchaser must be known to the seller and a record must be kept. On the other hand, for practical purposes, the only restriction on substances not in the First Schedule is that they must be labelled in accordance with the Act and Rules and they must be in the type of container required by the Rules.

Mr. Perrins also pointed out that preparations sold by manufacturers to doctors or veterinary surgeons more or less in bulk do not come under the heading of medicines 'made up ready', and emphasised that the Rules are to be administered by those who could be trusted to act with commonsense. The view taken in the report of the Departmental Committee is that the control of poisons is such an intricate and complicated matter, so liable to change, that it is impossible to deal with it by restrictions set out in an Act of Parliament. Much elasticity is necessary and questions of control must be dealt with by regulations which can be altered from time to time. Should it be found, for example, that these Rules work harshly on the trade in a particular raw material which does not in practice afford any danger to anyone, a fact which may have been overlooked, then that can be dealt with by a Rule adding it to the general exemptions or special exemptions as may be required.

In the discussion which followed, a number of points were raised in regard to the detailed interpretation of the Rules. It was emphasised that there are no responsibilities placed on the manufacturer as to whom he sells poisons, provided he does not sell them by retail to members of the public.

The question of abbreviated names was raised, the abbreviations used in the British Pharmacopœia being regarded as official, and it was suggested that the Association should recommend that the ordinary abbreviated names used in the trade should be considered to be accepted scientific names, a proposal which will not commend itself to the profession of chemistry generally. Various questions relating to transport and labelling were raised, but as the Report itself emphasises, the Board does not propose to include any industrial poisons in the List solely on the ground of the possibility of danger arising during transit, in view of the rules to be issued under the Petroleum

(Consolidation) Act, 1925, for the control of the transport by road of dangerous liquids and liquefiable gases.

It was pointed out that as Rule 20(*a*) stands, analytical laboratories which cannot claim to be engaged in education or research must have their bottles fluted, and it was suggested that samples used in examinations do not constitute supply and accordingly need not be specially labelled.

The second set of questions has been raised in a letter in *The Times* of July 6 by Prof. E. C. C. Baly and relates to the qualifications to be possessed by those authorised to supervise or control the manufacture of poisons and particularly to the nature of the prescribed qualification in chemistry. Prof. Baly points out that in Paragraph 65 of its Report, the Board, after recommending that the control of the manufacture of pharmaceutical preparations for the internal treatment of human ailments should be restricted to registered pharmacists, medical practitioners, fellows and associates of the Institute of Chemistry, and persons who have been continuously engaged in the control of the manufacture of pharmaceutical preparations for a period of three years, makes the erroneous statement that there is in Great Britain no recognised body other than the Institute of Chemistry that issues certificates or other documentary evidence of competency in chemistry as such. Not only does the British Association of Chemists issue such documentary evidence but also the universities, and the Report refers to university degrees and diplomas in such a way as to suggest that a university degree does not confer competency in chemistry as such.

Prof. Baly also directs attention to the suggestion in the Report that the societies named are included because they can exercise disciplinary action by removing a name of a member guilty of unprofessional conduct. Exactly the same action can be exercised by the British Association of Chemists, and Prof. Baly emphasises that the statements in the Report are the more unacceptable to a large body of chemical opinion because the Institute of Chemistry does not represent more than 40 per cent of the chemists in Great Britain.

In a reply in *The Times* of July 11, Sir Gerald Bellhouse points out that the proposed rule only applies to the manufacture of pharmaceutical preparations for the purposes of the internal treatment of human ailments, and not to the manufacture of the ingredients of the composition. The statement regarding the Institute of Chemistry, challenged by Prof. Baly, was primarily a reference to the fact that the Institute of Chemistry is the only institution connected with the profession of chemistry which has acquired the right, granted by Royal Charter, to confer definite qualifications in chemistry. The Board's recommendations in regard to the supervision of manufacture should be considered in regard to all the various legal and administrative questions set out in Paragraph 65 of its Report.

Norwich Meeting of the British Association

Final Programme

THE full programme of the Norwich meeting of the British Association should be in the hands of members next week, if they have intimated intention to be present. The programme has taken shape no less effectively than usual out of the general plans which were prepared at the meetings of organising sectional committees in January last. There is no doubt that the now regular practice of calling all these committees to meet early in the year on one day and in one place (recently, Birkbeck College, London) is the most successful administrative reform introduced into the working of the Association in recent years. It has had a notable effect upon the co-ordination of the final programme, which was urged as desirable in the columns of NATURE shortly after the Association had resumed its post-War activities. It is due to the memory of the late general treasurer, Dr. E. H. Griffiths, to associate his name with this exceedingly valuable measure: he introduced it.

The subjects of the presidential addresses have been indicated in an earlier notice (NATURE, May 11, p. 778). They range as usual from strictly technical essays in the pure sciences to those to which the layman will listen with ease, such as that of Dr. Pickard-Cambridge under the provocative title of "Education and Freedom". Some of the addresses will introduce discussions in their Sections: examples are that of Prof. W. N. Haworth on the molecular structure of carbohydrates, Prof. F. Balfour-Browne's on the

species problem, and Dr. J. A. [illegible] on the financial and economic results of State [illegible] in agriculture.

Most of the sections have developed the practice of ranging many, if not all, of the communications they are to receive under specific headings of discussions or symposia: it is probable that sufficient opportunity is still left for independent speakers on their own individual subjects; and the provision of major topics adds weight, and, from the public point of view, interest to the programme. One can even conceive of lay members finding their way to Section C (Geology) for the sole purpose of discovering what is meant by rank in coal. Nor should even these members, the cultivation of whose interests is a first charge upon the Association, be neglectful of the opportunities offered by such discussions as those in Section A on nuclear physics (to be opened by Lord Rutherford) and on new stars; the geological relations of early man in East Anglia, or, again, denudation chronology (Section C); and the herring problem (Section D).

Our previous article has referred to other discussions which need not be recapitulated; but the bald titles set out in the preliminary programme issued last May are now found to have concealed unexpected interests. For example, the subject of noise then entered under Section A is seen to indicate a demonstration lecture by Dr. G. W. C. Kaye involving elaborate and generous preparation. Films now find their regular place in Association programmes, thanks to the help of those who are willing to lend and demonstrate them, though it is to be feared that arrangements for showing them must have added to the task of the local executive. The Department of Industrial Co-operation has in its programme films illustrating industrial-educational and industrial management features. Dr. Sydney Long will show to the Conference of Delegates of Corresponding Societies a film illustrating the Norfolk bird sanctuaries. Section D (Zoology) has an afternoon and evening devoted to film work, including Col. Seymour Sewell's lecture on the John Murray Expedition to the Arabian Sea, Prof. Julian S. Huxley's "Private Life of the Gannets", and an exhibit by British Gaumont Instructional Films. The Gaumont-British Corporation, Ltd. will show to Section L (Educational Science) films illustrating physical education.

Both Norwich and the neighbourhood have taken advantage of the readiness of the Association to provide public lectures if desired. Sir Arnold Wilson will speak at Norwich on "Science and Population Problems", and Prof. W. Garstang will speak to young people on the songs of birds. There will be external lectures at Cromer, Fakenham, Yarmouth, King's Lynn, Lowestoft and Thetford, and the speakers will be Mr. A. Corless, Dr. B. A. Keen, Mr. M. Graham, Prof. A. Ferguson and Prof. W. T. Gordon.

The "Scientific Survey" which now, on a systematic plan, is published annually in lieu of the old local handbooks (which, however excellent in themselves, followed no model) will cover briefly every scientific aspect of Norwich and its neighbourhood. Of the unusually extensive interests of the district, the ample and wide-ranging series of sectional excursions affords evidence. In addition to the usual publications connected with the meeting, it should be observed that through the generosity of Sir Sidney Harmer copies of the paper and the fine map dealing with the distribution of erratics and drift, by his father, the late F. W. Harmer, will be available for distribution in the geological and geographical sections (C and E); furthermore, the local committee will provide for distribution in Sections E (Geography) and M (Agriculture) copies of the appropriate maps prepared by the Land Utilisation Survey.

In addition to the customary civic reception by the Lord Mayor and Lady Mayoress, which will be given in the quite unusually fine setting of the Castle Museum, there will be a garden party given by H.M. Lieutenant for Norfolk, Mr. Russell Colman, and Mrs. Colman, in the beautiful grounds of Crown Point. It is satisfactory to notice that an attempt is made to keep the time of this engagement, which falls on the Tuesday afternoon, clear of the encumbrance of official engagements. The usual hour of the Committee of Recommendations has been advanced, and the final meeting of the General Committee will be held on the last Wednesday at noon, instead of the Tuesday afternoon. There will also be a garden party at Norwich Aerodrome, when special displays will be given by the Royal Air Force in conjunction with the Norfolk and Norwich Aero Club.

Among other amenities connected with the meeting, the programme indicates the floodlighting of the Guildhall, the Castle Museum and some of the buildings adjacent to the Cathedral.

As not uncommonly happens, there is an unnecessary impression abroad that lodging accommodation will be difficult to obtain in Norwich. It is true that the hotels are full, and so will be the Training College hostel, but other accommodation can still be obtained, and is not likely to fall short, while for those whose freedom of action permits of their spending their nights in one of the coast resorts, special railway facilities are promised.

Obituary

Mr. G. E. Collins

THE melancholy accident on July 30 that deprived England of a soaring pilot of international reputation has also caused a serious loss to meteorology. Mr. G. E. Collins only began gliding in 1932, and with extreme rapidity acquired very great technical skill. But above all he had insight and imagination: he was always trying to increase, and to apply, our knowledge of air-currents. He was in close touch with some of the finest German pilots, and like them made use of cumulus clouds and 'fronts' to gain height that could be converted into horizontal travel. He learned from Wolf Hirth the method of soaring in a spiral in a 'thermal' (an up-current without a cloud to mark it) by the use of a variometer, steering in the direction in which the uplift was greatest; but he soon discovered a method of soaring in thermals without a variometer, using his body sensations and steering towards the wing which was the more strongly lifted. To-day probably a dozen British pilots can climb in thermals, but they owe much to Collins's peculiar gifts.

Collins was among the foremost to make use of the up-currents suggested by theory under the long lines of cloud that form parallel to the wind direction, realising their value for flights down-wind. Accordingly, in August 1934 he employed these 'cloud-streets' in a flight of 98 miles from Dunstable to Holkham Bay, still the British record: he reached the Norfolk coast at a height of 3,000 ft., and showed that it is only the dimensions of our island that impose the limit on cross-country flights.

In July last year, Collins extended ideas by providing a reply to the criticism that gliders can only sail down-wind. In a flight in a west-south-west wind, he passed over Watford and alighted at Hanworth, due south of it; his speed relative to the air was not only much faster than the wind, but its direction must have been within 45° of straight into it. Now that tacking is possible, much can be done.

It had been hoped that Collins's skill might have been employed in carrying self-recording instruments round and through clouds in order to get much needed data procurable in no other way; may his fine example inspire others to take up this work.

G. T. W.

Dr. Helen Chambers

BY the death of Dr. Helen Chambers on July 21, Great Britain has lost one of its most devoted workers in the cause and treatment of cancer. She received her medical education at the London School of Medicine for Women, took her M.B. with first-class honours in 1903, and was a gold medallist. At twenty-four years of age, she was appointed pathologist to the Royal Free Hospital, a post she held until 1915, when she resigned to take up a similar position at the Endell Street Military Hospital. Before the War she had been doing part-time research work in the Cancer Research Laboratories of the Middlesex Hospital, and when the military hospital closed she accepted full-time work there under the Medical Research Council.

Only the comparatively few people who came into intimate touch with Dr. Chambers realised her full value. Her wide experience of general pathology and extraordinary ability to concentrate entirely on the matter in hand made her invaluable for research work. It was mainly due to her foresight and inspiration that the Marie Curie Hospital at Hampstead came into being. She realised that for satisfactory radium treatment it was essential to have the close co-operation of surgeon, physicist and pathologist, and the excellent results of treatment of uterine cancer at that hospital show to what an extent she succeeded in securing this collaboration.

Dr. Chambers contributed many papers to the scientific press on the effects of radiation on malignant and normal cells. The fact that animals, after the absorption of malignant tumours which had been very accurately irradiated, were often immune to tumour growth was always at the back of her mind for its possible clinical application. So recently as last winter she spent several months in Paris, where she carefully studied the X-ray treatment of cancer of the breast by Prof. Coutard, whose methods she felt gave more hope of attaining this desired effect than any other treatment of the disease in use at the present time.

Mr. J. H. Ronaldson

JAMES HENRY RONALDSON, who died on August 5, was a very well-known and much respected consulting mining engineer and geologist. He was born in the county of East Lothian and received his scientific and technical education at the Universities of Edinburgh and Liège. He travelled widely, but was probably best known in Australia and South Africa, where he had resided for comparatively long periods. He made London his headquarters as from 1910, and his business, until the outbreak of the Great War, took him to all sorts of countries. Shortly after the outbreak of the War, he found himself in the Ministry of Munitions, but after a short period of service there, Messrs. Brotherton and Co., Leeds, who had gone in for the manufacture of munitions, applied for his services, and he supervised their manufacture of explosives until 1918. After that he continued his practise, and for a few years was associated with Dr. William Cullen in consulting business.

Ronaldson was not only an excellent mining engineer but also a very good geologist, and it was this happy combination which made his reports so valuable to those who employed him. Moreover, he was the soul of integrity, and he never allowed

himself to be carried away by the influence of others who may have examined the same property. His clients, therefore, knew that when he prepared a report it was an honest one, and uninfluenced by expectations on one side, or performances on the other. Although he was connected with many scientific and technical institutions, he was never addicted to the writing of papers. Indeed the only one on record is a joint one by Dr. Cullen and himself, which deals with a purely technical aspect of mining, but which is still of reference value.

He did not take an active part in discussions on technical subjects, but whenever he did intervene he was always listened to with great respect, because his audience recognised that his experience covered a very wide field.

News and Views

Dr. Griffith Evans's Centenary

DR. GRIFFITH EVANS celebrated his hundredth birthday by an at home at Bangor on Wednesday, August 7 (see NATURE of August 3, p. 173). He had on the previous evening been visited by two veterinary colleagues, Capt. W. H. Savage and Sir Frederick Hobday. Although, through the bad luck of two very severe accidents involving fracture of each thigh, Dr. Evans is bedridden, his mental faculties are wonderfully alert. In accordance with his own request the presentation from his Alma Mater, the Royal Veterinary College, was the first of the series of the ceremonies which had been arranged to do him honour. Sir Frederick Hobday, in presenting the congratulatory scroll, said: "As a great pioneer we are proud of what you have done for veterinary science and we wish you continued good health to see still further, for many years to come, the progress in comparative medicine—which was initiated by the discovery you made of the parasites in the blood—when investigating (whilst a veterinary officer in the British Army) the disease known as 'surra' in horses and camels". The presentation scroll is framed in a piece of the wood of the old College. In acknowledging the presentation, Dr. Evans referred to his early years at the Royal Veterinary College and recalled characteristics of his teachers, Profs. Spooner, Simmons and Morton. After this address, a telegram sent on behalf of Their Majesties the King and Queen was handed to Dr. Evans; it read as follows:—"The King and Queen are much interested to hear to-day you are celebrating your hundredth birthday, and desire me to convey to you their hearty congratulations. Their Majesties are aware of your distinguished services to veterinary science and send you their best wishes on this great anniversary." Telegrams of congratulation were also received by Dr. Evans from H.R.H The Prince of Wales, Mr. Lloyd George, the Council of the Royal College of Veterinary Surgeons, and the citizens of Bangor, among others.

Unknown Papua

A SURVEY expedition to northern Papua under Mr. J. G. Hides, assistant resident magistrate, and Mr. James O'Malley, patrol officer, returned to Port Moresby on July 20 after an absence of eight months, in which at the cost of great hardship much previously unexplored country was crossed, and unknown groups of natives encountered. The area explored lies between the sixth and seventh parallels of south latitude and the 142 and 114 meridians of east longitude. The party started in December last, travelling up the Fly and Strickland Rivers and then along the Carrington River, an unexplored tributary of the Strickland, until navigation became impossible. Boats were then abandoned, and the expedition struck across country overland for the Purari River, which was reached after an arduous four months in which the party was reduced to the verge of starvation, owing in part to the attitude of the natives who, though at times graciously friendly, at other times refused them food and generally displayed an attitude of contemptuous and thinly veiled hostility.

ACCORDING to an account of the expedition which appeared in the Melbourne *Argus* of July 23, after leaving the Carrington, the party in twenty days passed through a desolate limestone barrier and penetrated a vast fertile valley, 20–30 miles broad, under cultivation by a large population of short, brown-skinned, mop-haired people of an "Asiatic type", calling themselves Tari Furora. Both men and women till the ground, using wooden spades. They refused gifts of steel. No communal villages were observed, and the people seem to live in individual families. The same people were found on a high grass tableland traversed in April and May, where an estimate of their numbers is given as 100,000. As the party travelled east and south-east the type gradually changed and men were observed wearing bear's tusks as nose ornaments. A preliminary report on the expedition's work has been presented to the Lieutenant Governor, Sir Hubert Murray. An official account was published in Australia on August 13, and an account appears in *The Times* of August 14.

Further Discoveries at Colchester

EXCAVATION, resumed on the Romano-British site at Colchester early in July, continued to produce evidence, mainly in the form of pottery, of the importance of the pre-Roman city as a centre of foreign trade and native British industry. Early in

August, however, investigation was given a fresh impetus by the discovery of vestiges of a remarkable character of what at first sight was thought to be a building of considerable size, assigned tentatively to the last decade of the first century A.D., on the evidence of a coin found on the floor of what appeared to be a kitchen. Further excavation showed that this identification of the character of the structure was premature. The new discovery can now be seen to be of far greater importance, and indeed, in certain respects it seems unique. The wall, so far as at present uncovered, a distance of some 230 ft., according to a report in *The Times* of August 10, runs east and west almost in a straight line. The foundations, which remain *in situ* to a height of several inches, vary in breadth from 2 ft. 6 in. to 3 ft. At regular intervals of 17 ft. on both faces of the wall are small buttresses, 2 ft. square in plan. The method of construction is interesting. It points to a severe economy on the part of the builders, no doubt owing to the scarcity of suitable stone in East Anglia. The core of the wall is composed of a coarse gravelly rubble with a frequent mixture of broken amphorse, mortaria and roof-tiles. Only a few fragments of the stone coping remain. The excavators hesitate to offer any conjecture as to the purpose of the wall; but they are of the opinion that it is probably unique in the British Isles.

Civilian Respirators

UNDER the title "Civilian Respirators" an article in the August issue of the *Industrial Chemist* discusses the general requirements of apparatus for the protection of the civilian population in the event of hypothetical hostilities involving the use of lethal gases. It is well known that public opinion is divided on the question whether it is desirable to discuss these matters in the present temper of Europe. Some hold that peace is endangered by even humanitarian preparations in case of war; others consider that it would be folly to ignore the possibilities of a new form of warfare, and that common prudence dictates the examination of all measures necessary to combat it. In any event, if measures are to be taken, it is at least common sense to take the best available; and in this matter of the design of respirators suitable for civilian use, the article to which we refer suggests to potential inventors the following general requirements: (1) A canister should be attached directly to a complete facepiece. (2) The canister should provide a protection of 2 minutes against 1 per cent of phosgene, and 20–30 minutes against 0·1 per cent. The resistance should not exceed 3 in. of water. Protection of 10 minutes against 1 in 5×10^7 of diphenylchlorarsine or diphenylaminechlorarsine should be provided. The canister should be readily replaceable and should last for at least five years. (3) The facepiece, of rubber or leather, should be gastight, in not more than three sizes, and should incorporate eyepieces or a window. It should be simple in design, should interfere as little as possible with ordinary duties, should be suitable for mass production from materials available in Great Britain, and should last for at least five years. (4) The cost should be as low as possible. Let us equally bear in mind that industrial respirators and their possibilities are already familiar in chemical factories, and that any new advances will be of great interest in many peaceable occupations.

Direction Finding and Blind Flying for Civil Aviation

IT has been announced that the Directorate of Civil Aviation, Air Ministry, and the National Physical Laboratory, are co-operating in the study of problems relative to 'blind' flying as applied to air-line operation. The immediate necessities are three-fold, and the use of wireless transmission appears to offer the most likely means of their solution. They are: (1) The transmission of direction finding information over as long a range as possible, probably by short-wave radio. (2) Devices for warning the pilot of the proximity of obstructions such as high masts, or even other aircraft, in conditions of poor visibility. (3) The accurate guiding in and landing of aircraft when an aerodrome is obscured by fog, or in any similar conditions of reduced visibility. The Air Ministry is using a Vickers "Viastra", until recently the property of the Prince of Wales; it will be fitted with the necessary apparatus as soon as preliminary experiments have indicated the most promising type, and will be flown by Imperial Airways pilots. The aerodromes from which they will operate will probably be Croydon, Gatwick, and Gravesend. Imperial Airways will also be invited to send out signals at pre-arranged times, to the pilots of their normal machines, when over Africa and on the way to India and Australia, from which the reliability of different systems can be judged. A type of 'approach' beacon for blind landing, giving out a short aural note over a range of 20–25 miles, has already been ordered for experiment. If this is successful, the problem will then be to develop the use of a long-range direction finding system for use in conjunction with the short-range system, but without interfering with it.

Television in Great Britain Next Year

THE Postmaster-General has now authorised the B.B.C. to make arrangements with the Baird Television Co., Ltd., and the Marconi–E.M.I. Co., Ltd., for the provision of complete transmitting equipment for the operation of their respective systems at the Alexandra Palace, where constructional work has already begun. It is hoped that transmissions will start in the early part of next year, and will be followed as soon as practicable by a regular public service. As ultra-short waves will be transmitted, it will be possible to broadcast scenes in much greater detail than can be done to-day. Doubtless before very long many listening-in sets will be furnished with a television screen. In Germany, television is being pushed forward for political reasons; but in the United States although experimental television is an accomplished fact the business and advertising aspects of the new industry have to be carefully considered. In Great Britain luckily advertisement does not need to be considered, and the Government

dominates the whole position. The masts on the Alexandra palace will probably be about 600 ft. above sea-level, and there are few local obstructions. In the London area, it is understood that a wave-length of 6·6 m. will be employed for the visual and 7·2 m. for the sound broadcasts. As these rays are propagated in practically straight lines, their range does not extend much further than the visual horizon. The London area will be roughly a circle of radius 30 miles. There are some outstanding financial problems that have to be settled, such as the relative values of the televising and broadcasting rights of a prize fight. In the cinema industry, coloured pictures have greatly improved, so that it only needs stereoscopic projection to perfect them.

Effects of the 1934 Drought in the United States

IT was only to be expected that the American drought of 1934 would extend well into the growing season of 1935, in some parts of its extensive area, and this is proving to be the case. In a number of articles that have been issued by Science Service, Washington, D.C., during the past few months, the gradual contraction of the stricken area has been traced. In one such article, dated March 13, early spring rains in the Plains were mentioned, and a great excess from the Ohio Valley to the Gulf, sufficient to delay spring ploughing. On March 27 light rains were described as having eased the situation in the northern part of the western drought area; but dust storms were reported in the completely dry region in eastern Colorado and western Kansas and in Texas. On April 20 an improvement was noted in Texas and Oklahoma, and a hope on the part of the forecasters in the Weather Bureau that western Kansas and eastern Colorado might soon be relieved by invading depressions. Articles dated May 1 and 2 showed that this hope had not been fulfilled, the area in question remaining to represent the temporary "Great American Desert". A faint sprinkle of rain was described as having evaporated as fast as it fell in Dodge City. In the relieved areas, the cold weather and sodden fields, and the resultant delay in farming work, were said to be accepted with complacency after the previous extremes of drought and heat.

DUST storms, leading to the loss of the cultivated surface soil, had become a commonplace occurrence in the United States before the drought had nearly reached its greatest extent, causing great inconvenience and material damage to the States lying to the eastward of the driest region, as well as to western farmers. The drought itself is held, however, to be only partly responsible, as the dry soil would not have been blown away had the Plains not largely been deprived of their former permanent grass covering, of which the roots would have bound the soil in place through even the worst periods of deficient rainfall. Another article describes one of the processes whereby the drift of loose soil has been to some extent countered. This process, known to farmers as 'listing', consists of specially deep ploughing with the aid of motor-driven tractors. A special plough is used, which throws the soil on both sides; the furrows may be as many as fifteen feet apart, and are driven at right angles to the prevailing winds, which are generally from the north-west. Where the soil is heavy the tops of the ridges are covered with something more coherent than the normal surface tilth, and this partly accounts for the efficacy of the method, which, however, is due mainly to the fact that as the loose soil begins to move under the action of the wind, it tends to fall into the furrows and to be trapped in them. It is stated that the Soil Erosion Service does not regard this 'listing' as a solution of the problem of wind-erosion, the real solution being to restore the permanent grass, much of which was ploughed up during the War so that cereals could be grown.

List of British Vetebrates

FEW naturalists have at hand complete lists of the various groups of British vertebrata, and yet in the absence of such lists reference and checking often become unutterably tedious. The suggestion of the Association of British Zoologists that a complete check list of all British vertebrates should be compiled was, therefore, a sound proposal, and the list as it now appears will prove of value in many ways, especially to workers of wide interests. This is clearly due to the way in which the British Museum (Natural History) has applied itself to carrying out the suggestion, for apart from the Bird list (by B. W. Tucker) the work of compilation has fallen upon the Museum staff, and for the editing and publication it also has been responsible (pp. 66, price 1*s*.). The list is a check list and no more, giving the Latin and English names of species and often indicating by letter symbols something about the status. In contrasting this check list with the lists of other countries, one's first impression is that it is a short list, representing a land fauna not outstandingly rich in variety, and a second strong impression is that, much less than other countries, Britain has been subjected to the successful introduction of foreign animals. To the short list of animals marked as introduced should be added, amongst the mammals, the rabbit, the black rat and the brown rat, and the Japanese deer, *Cervus sika*, which is very much at home in part of the western highlands of Scotland and was introduced so long ago as 1887; amongst the birds, several species of pheasant, for *Phiasianus colchicus* is now a rare species in the coverts, its place having been usurped mainly by *P. torquatus*.

Traffic-actuated Road Signals

IN a paper read before the Institution of Railway Signal Engineers by F. Edwards, an abstract of which appears in *Roads and Road Construction* for July 1, the development of systems of road signalling is described. There are two main developments which may be regarded as milestones in the progress of street traffic signalling. The first system is time-controlled and, thanks to the specification issued by the British Standards Institution, it works fairly well. Up to the end of February of this year, grants had been issued for the erection of signals at more than

1,700 crossings in Britain, and naturally the installation of all these crossings is costly. The second step in advance was the introduction of the vehicle-actuated method of control, which has several advantages over the time-controlled system. With the time-controlled apparatus the 'right of way' is given to each of two or more intersecting roads for definite periods of time in sequence, quite regardless of the relative volume of traffic on the roads at any particular moment. One of the essentials of any form of control is to keep traffic moving, and this should only be subordinate to safety. The time-controlled system is powerless to differentiate between the volumes of the flow of traffic in the various directions. Many attempts were made in the past to produce a system which would provide maximum traffic facilities with maximum safety. There are now two systems of vehicle-activated control in practice, called the electromatic and the autoflex respectively. In the former, a vehicle passing over a pad makes contact and completes an electric circuit; in the latter the air in a channel in a rubber moulding is compressed and the compressed air produces the contact. The problem of co-ordinating a series of crossings is now being satisfactorily solved. Oxford Street, London, from Marble Arch to Tottenham Court Road is a good example of the advantages of this kind of control.

Invention of the Venturi Meter

In connexion with an article on "Early Hydraulic Engineering", in which the work of Clemens Herschel (1842–1930) is referred to, *Engineering* in its issue for August 2 reproduces a letter from Herschel to the late Dr. Unwin describing his invention of the Venturi Meter. The letter is dated June 5, 1888, and addressed from the hydraulic engineer's office of the Holyoke Water Power Co., Mass. In his letter, Herschel says he tested a one-inch Venturi Meter, under 210 ft. head: "I am now satisfied that here is a new and pregnant principle to be applied to the art of gauging fluids, inclusive of fluids such as compressed air, illuminating or fuel gases, steam, etc. Further, that the shape of the meter should be trumpet-shaped in both directions; such a meter will measure volumes flowing in either direction, which in certain localities becomes a useful attribute. . . . And we are but in the beginning of the art of measuring pressures, and differences of pressure. When these shall be delicately measured, the Venturi Meter will have become as delicate in its lower limits of capacity, as any other and it is on this score *alone*, that it is as yet inferior to some of the volumetric meters." The letter was found among the papers placed at the disposal of the Unwin Memorial Committee by Miss Unwin.

Electric Welding in Industry

The American Welding Society has awarded the S. W. Miller Medal to J. C. Lincoln, the founder of the Lincoln Electric Company, as the first to apply the electrical arc to building construction, and for his improvements in the art of arc welding. Mr. Lincoln has pointed out that by arc welding the cost of the repairs of machines has been greatly reduced. It has eliminated the noise of the riveting hammer in building construction. A joint made by arc welding is often stronger than the parent metal; while a joint made by riveting never is. The amount of the material needed for the structure is therefore considerably reduced. It is of particular importance in marine construction, where the smooth outline rendered possible by welding appreciably increases the speed of the ship. The most widely used application of all is the replacement of steel and iron castings by welded structural steel. This application gives a method of having a lighter, stronger and cheaper material than it is possible to get by casting. Already about one and a half million tons of castings a year have been eliminated by this method. Mr. Lincoln thinks that welding will entirely eliminate the rivet as a method of joining structures. It will also largely increase the value of worn and broken parts.

Industrial Physicists

The *Review of Scientific Instruments* reproduces in its issue of February the conclusions of the Conference held in New York to consider "the place of physics in industry and the best methods by which that place can be fully occupied". The Conference demands a training which shall develop: (1) a broad knowledge of the principles of physics with a leaning towards classical physics; (2) an intimate working knowledge of the more elementary branches of mathematics; (3) a grounding in the principles of chemistry sufficient for physical research; (4) power of expression in technical and especially non-technical language; (5) realisation that a research worker in industry is justified only by his value to the industry. It would be of great interest to discover whether these are the demands of industry in Great Britain, and if so, whether the training required is being provided by our educational methods.

Institute of Plant Industry, U.S.S.R.

A list of the publications during 1933 of the Institute of Plant Industry, Leningrad, compiled by Strumillo, appears as Bibliographical Contributions No. 4 of the Institute. The list of publications of this Institute, and of the old Bureau of Applied Botany which preceded it, is thus now complete from 1908 to the end of 1933. It covers 57 publications, is published in Russian and English, and the titles of all contributions of every volume are given in English even in cases where the originals contain no English summary. Most of the Institute's publications of specialised character have English summaries; those publications in this list which are not provided with one are indicated. The *Bulletin of Applied Botany, of Genetics and Plant Breeding*, together with its supplements, occupies the major portion of this list. The remainder is occupied by non-serial publications and by publications originating from the Institute, but issued by other publishers. "Plant Industry in the U.S.S.R." and "Agricultural Turkey" are two important contributions in the latter category.

Indexes arranged according to subjects and to authors are provided. The importance of the work of the Institute of Plant Industry, the extent of its activities, and the diversity of its serial and non-serial publications, make its bibliographical publications indispensable to applied botanists.

Ocean Transportation of Petroleum in Bulk

OWING to world trade depression and to production problems within the industry, there is now actually available excess oil tanker tonnage over demand. Of the world's steam tanker tonnage 44 per cent is, however, more than fifteen years old, consequently new tankers will shortly have to be constructed to replace these and to meet anticipated increase in demand when trade recovers. Mr. R. F. Hand read a paper on April 5 before the North East Coast Institution of Engineers and Shipbuilders, in which he indicated some of the problems attendant on ocean transportation of petroleum in bulk. Great care must be exercised in allocating vessels for specific work, account being taken of condition, size, position and capability of the tanker to carry the cargo in question. Freights cannot be imposed on a basis of cost plus a reasonable margin of profit, but must be fixed at a rate which the traffic can bear. Ultimate profit must be envisaged over a number of years, and provision made for periods when goods may actually have to be carried at a loss. A classification is suggested for petroleum products from the point of view of marine transport and types of vessel most suitable for carrying the various grades indicated. Operating costs are difficult to assess at the present time owing to the complex foreign exchange situation; but such data as are available prove that though the motor tanker is more economical for long hauls it is not always so in the case of short hauls.

The Science Museum

ACCORDING to the Report of the Science Museum for the year 1934 (London: H.M. Stationery Office, 1935, 1*s*. net) well over a million visitors have made use of the Museum, including more than a thousand organised groups and parties of about thirty, and the attendances at lectures were well over 30,000. The policy of holding special exhibitions to illustrate the advance of science into industry has been most successful, and the attendance at those on refrigeration from April until September 1934 and on rubber from November 1934 until April 1935 was very gratifying. The children's gallery has been visited by 13,000 children in school parties, and the introductory collection installed there has proved very attractive. Short accounts are given in the Report of the progress in each of the five divisions: industrial machinery and manufactures, mechanical and civil engineering, air and water transport, mathematics, astronomy and chemistry, physics and geophysics, and it is quite evident that the delay in reconstructing the central block is a serious obstacle in the way of a more instructive display of the material now crowded into inadequate cases. The Science Library now possesses a quarter of a million books, and nearly 50,000 readers have made use of them. The free space for new books is nearly exhausted and temporary housing will have to be provided until the central block becomes available.

Fuel Research Institute of South Africa

DR. J. G. VOGEL, director of the Fuel Research Institute of South Africa, has recently described the activities of the Institute (*S. African J. Sci.*, **31**, 194–209, Nov. 1934). Initially, the Union Government wished to encourage the export trade in coal, and prevent the damaging effect on the export of coal of unreliable grade. Now all coal loaded for export or bunkers must be graded by the Institute before shipment. The programme is determined by the fact that the coal industry is neither very old nor extensive, and the information available is limited. A first step is therefore a chemical survey. Already the Institute has made a notable contribution to the difficult problem of coal sampling by devising a novel sampling device. It consists essentially of a rotary drill working inside a sheath, up which a rapid current of air passes. The air and the coal abraded by the drill are drawn into a container after the manner of a vacuum cleaner, where the solids are retained. This apparatus not only enables samples to be collected from seams, but also from waggons—a problem which has not hitherto received a satisfactory solution. The Institute is equipped for research in coal chemistry and coal processing, and also for the study of liquid and gaseous fuels.

Census Statistics

THE normal series of publications dealing with the figures of the 1931 census is completed by the issue of General Tables, a volume of some two hundred and fifty pages (London: H.M.S.O. 11*s*.). It contains tables giving the populations by sex of the constituent regions of England and Wales—counties, boroughs, urban and rural districts—showing the changes that have occurred in recent intercensal periods. It also gives an analysis of the age and marital condition of the population at successive censuses during the last ninety years. Particulars are given of the birth-places and nationalities of the population in regions, boroughs and other urban areas, and comparative figures for England and Wales at successive censuses. There are also figures of population speaking the Welsh language. Much of the information given in the volume has hitherto been obtainable only by laborious extraction from separate county records.

The Imperial Institute

WE have received the annual report of the Imperial Institute, recently presented by the director, Sir Harry A. F. Lindsay, to the Board of Governors (London: Imperial Institute, 2*s*.). This gives a general account of the activities of the Institute and details of many special investigations which have been made with Empire products. These comprise work on silk, cordage fibres, tung oil, shellac, hides and leather, oil seeds, tanning materials, drugs and insecticides,

and the analyses and investigations of various minerals. The report directs attention to the wide range of valuable minerals produced in the Union of South Africa. The use made by the public of the exhibition galleries, and the provisions made for educational purposes are dealt with in the report, which indicates clearly the very useful purposes served by the Imperial Institute.

The Italian Seismological Society

THIS well-known Society has now existed for forty years, and the first number of the new volume of the *Bollettino* (**33**, 10–21; 1935) contains a brief survey of its history by the present secretary, Prof. G. Agamennone. The study of earthquakes as a whole in Italy may be said to have begun in 1870 with the works of Bertelli and De Rossi; but the issue of the *Bullettino del Vulcanismo Italiano*, founded by the latter in 1874, was declining after twenty years. The Italian Society, in imitation of its Japanese predecessor, was founded in 1895 under the direction of Prof. P. Tacchini, the director of the Central Office of Meteorology and Geodynamics, and continued ten years later under that of his successor Prof. L. Palazzo, the present president being Prof. G. Cicconetti. The activity of the Society may be judged from the volumes of the *Bollettino* so far published, which contain nearly 500 papers occupying more than 9,000 pages.

Cambridge Microtomes

THIS year the Cambridge rocking microtome, one of the most familiar instruments in biological laboratories, attains its jubilee. The Cambridge Scientific Instrument Co., Ltd., has issued a new folder, illustrating this instrument and also a more heavily built and modified form of it for cutting flat sections of larger objects. The folder shows in addition a massively built sliding microtome, the design of which was completely overhauled two years ago, which cuts large sections, 60 mm. × 60 mm., in either paraffin or celloidin, and a freezing microtome of new design. Hints on the care and sharpening of microtome knives are added.

International Society of Leather Trades' Chemists

THE bi-annual conference of the International Society of Leather Trades' Chemists, in conjunction with that of the Internationalen Vereins der Leder Industrie Chemiker, will be held on September 1–6 at the Institut des Arts et Metiers, 50 Boulevard de l'Abattoir, Brussels, Belgium. The reception of members and visitors will take place on Sunday evening, September 1, at 8 p.m., at the Palace Hotel, Place Rogier, while the official banquet, at which the Burgomaster of Brussels will be present, together with other representatives of civic, commercial and scientific bodies, is fixed for Wednesday, September 4. Some thirty papers are to be read and discussed. Further details can be obtained from M. A. Fievez, 7 rue d'Audiger, Soignies, Belgium, or from the Honorary General Secretary of the I.S.L.T.C., 17 Market Street, London, S.E.1.

Announcements

PROF. J. A. NIXON and Dr. R. E. Lane have been appointed to fill vacancies in the membership of the Industrial Health Research Board.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. A. W. Gledhill, to be veterinary officer, Uganda; Mr. R. M. Davies, district agricultural officer, Tanganyiki, to be senior agricultural officer; Mr. S. P. Teare, game ranger, Tanganyika, to be game warden.

THE Managers of the Royal Institution have awarded the Dewar research fellowship to Mr. A. R. Ubbelohde, formerly Senior Scholar of Christ Church, Oxford, and at present holder of a senior research award of the Department of Scientific and Industrial Research. Mr. Ubbelohde will take up his new appointment in the autumn. His researches have been largely in physical chemistry, and it is expected that his experience will be valuable in connexion with the researches directed by Sir William Bragg at the Royal Institution on the structure of matter.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Scientific Officers (Ref. A. 764), junior scientific officers (Ref. A. 765), and assistants, grades I–III (Ref. A. 766–8) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Aug. 17).

An assistant signals officer and a signals officer in the Signals Branch, Air Ministry—The Secretary (S 1, Room 436), Air Ministry, Adastral House, Kingsway, W.C.2 (Aug. 19).

A senior lecturer in the Department of Pure and Applied Science, Loughborough College—The Registrar (Aug. 24).

An engineer officer in the Public Works Department, Buildings and Roads Branch, Punjab—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 26).

An assistant lecturer in the Department of Zoology, University of Leeds—The Registrar (Aug. 31).

An assistant lecturer in the Department of Physiology, University College of South Wales and Monmouthshire—The Registrar (Aug. 31).

A lecturer in morbid anatomy in the Department of Pathology, University of Aberdeen—The Secretary (Sept. 15).

A professor of mathematics in the University of Aberdeen—The Secretary (Sept. 30).

Temporary architectural and engineering assistants in the Directorate of Works and Buildings, Air Ministry, and at various aerodromes in the United Kingdom—The Secretary (W.B.9, Room 161), Air Ministry, Adastral House, Kingsway, W.C.2.

Temporary assistant mechanical and electrical engineers—The Secretary, Air Ministry (W.B.9), Adastral House, Kingsway, London, W.C.2.

A lecturer in geography and mathematics at St. Hild's College, Durham (Diocesan Training College for Women)—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 264.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Beta Processes and Nuclear Stability

1. IT is well known that the stability of the atomic structure is closely connected with the mechanical conservation laws. It has been shown that even the stability of the atomic nucleus, in particular the nuclear beta stability, is subject to conditions which can at least formally be interpreted as conservation laws for the mechanical integrals of motion[1]. It may be pointed out, however, that the application of the usual mechanical conservation laws only is not sufficient to account for nuclear stability.

If one assumes a coupling of the nucleus with the electron field, the mechanical conservation laws alone would not exclude transitions in which a nucleus emits two electrons simultaneously and thus changes its charge by two units. This process would not involve the occurrence of a so-called neutrino, and we should expect considerable transition probabilities for such transformations. The radioactive transformations, however, show no indication of this type of double processes. RaD, for example, emits only a single electron, a second electron being afterwards emitted by the product nucleus, RaE. We have to conclude from this fact that the simultaneous emission of two electrons is a higher order transition of very small probability, involving the simultaneous occurrence of two 'neutrinos'.

The question arises why the neutrino occurs even if the mechanical conservation laws do not require such a particle. We are led to conclude that the beta-transitions are subject to an additional condition. The simplest form in which such a condition can be expressed seems to be the following: "Any production of particles has to involve the simultaneous production of an equal number of antiparticles". Attributing a positive sign to particles, a negative sign to antiparticles, the above condition can be regarded as a conservation law for the total number of particles. In the case of the natural beta decay this rule can be easily satisfied if one calls the hypothetical second particle an 'antineutrino'.

So long as we confine our attention merely to the production of pairs of differently charged electrons, the conservation of the total number of particles is secured by the conservation of charge and thus does not require the introduction of any special assumption. Any theory of the beta decay using the concept of a neutrino has to abandon this connexion and has to introduce an additional condition beside the conservation of charge.

2. It has been suggested by several authors that the interaction between nuclear particles might be due to beta processes of higher order. The small probabilities of the beta transformations, however, make it extremely difficult to account for the actual order of the nuclear interaction. Prof. Lauritsen and Prof. Oppenheimer have kindly pointed out to me that the possibility of very high beta decay probabilities for high decay energies is incompatible with recent investigations on the beta decay of Li^8 and B^{12} and that therefore the beta decay must be due to an extremely weak coupling energy. This fact is very likely connected with the occurrence of the so-called neutrino.

I should like to point out here that it seems to be inconsequential to connect the nuclear interaction with the natural beta decay so long as there is no necessity to assume a neutrino to be involved in nuclear binding. We have to expect that the coupling between a nucleus and the electron field is very much stronger than the interaction with what is called a neutrino. It is only due to the restrictions implied by the conservation laws discussed above that the coupling between nucleus and electron field does not become effective in the natural beta decay. If we proceed, however, to higher order processes such as are involved in the above considerations on nuclear binding, these restrictions do not hold any longer and the weak coupling with the neutrino can be entirely neglected in comparison with the production of electron pairs. It may be found difficult, however, to reconcile even the known facts on the production of pairs and on the small isotope shift observed in spectral lines with the strong nuclear binding forces.

G. BECK.

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[1] For example, NATURE, 132, 967; 1933.

Beta Ray Spectra of Artificially Produced Radioactive Elements

WE have investigated a series of β-ray spectra emitted by radioactive elements obtained by neutron bombardment. The results of the measurements together with those previously published by us in NATURE are given in the accompanying table.

Atomic No.	Element	Half-life period (τ)	Max. energy (in kv.)	$\tau.F(\eta_0)$
7	N	11 m.	1,400	58
13	Al	2·3 m.	3,000	840
15	P	3 2 m.	3 600	1,400
15	P*	14 d.	2,050	630,000
25	Mn*	2 5 h.	3,200	50,000
35	Br*	18 m.	2,000	480
35	Br*	4·2 h.	2,050	15,000
35	Br*	36 h.	950	5,900
45	Rh	44 s.	2,600	170
45	Rh	3·9 m.	2,100 ?	420
47	Ag	22 s.	2,800	130
53	I*	25 m.	2,100	3,700
79	Au	2·7 d.	1,100	17,000
77	Ir	19 h.	2,200	585,000

Substances marked with an asterisk were separated by chemical methods analogous to those used by Szilard and Chalmers[1]. The radioactive manganese was separated from a solution of potassium permanganate, the radioactive P^{32} from carbon disulphide.

We tried to relate our results to Fermi's theory of β-ray decay. For this purpose it is necessary to calculate for each radioactive element Fermi's[2] function $F(\eta_0)$, where $\eta_0 = H\rho_{max.}/1700$. According to Fermi, the values of $\tau.F(\eta_0)$ should be distributed in two groups, differing from each other by a factor of about 100. The first group should correspond to allowed transitions, the second to the forbidden ones. As can be seen from the table, such a sharp separation into two distinct groups, as obtained by Fermi for natural β-active elements, can scarcely be found for the substances we investigated; also, the data obtained by us do not fit the well-known Sargent diagram.

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B. S. DŽELEPOW.

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Leningrad.
July 3.

[1] L. Szilard and T. A. Chalmers, NATURE, 134, 462; 1934.
[2] E. Fermi, *Z. Phys.*, B, 88, 161; 1934.

Velocity of 'Slow Neutrons'

A NEUTRON source (beryllium and 300 millicurie radon) was placed in the centre of a block of paraffin wax, of about 20 cm. diameter in all dimensions. After emerging from the paraffin, the neutrons had to pass, on their way to the detecting apparatus, through the marginal parts of a wooden disc of 50 cm. diameter and 2 cm. thickness, which could be made to rotate with a speed of 4,000 rev. per minute. This speed corresponds to a velocity of about 9×10^3 cm./sec. of the parts of the wood through which the neutrons penetrated. From former experience one would expect each slow neutron, while passing through the disc, to suffer a number of collisions with the protons contained in the wood, and therefore the velocity of the disc would be superimposed on their velocity distribution with the disc at rest. Assuming that a large part of the neutrons have thermal velocities, which are for neutrons of the order of 2×10^5 cm./sec., an asymmetrical distribution of the directions of the neutrons emerging from the rotating disc would result, about ten per cent more slow neutrons being emitted in the direction of rotation than in the opposite direction.[1]

In order to get evidence of this asymmetry, we placed a cadmium screen with a hole of 6 cm. × 6 cm. near the rotating disc, defining thereby a region where the neutrons were allowed to emerge from the wood. Two boron-lined ionisation chambers were placed behind the screen in such a way that they collected the neutrons projected at less than 45° and 135° relative to the direction of motion, respectively. The chambers could in turn be connected to a linear amplifier and mechanical counter; and alternative countings of equal duration were made with the disc rotating alternately one way or the other.

The experiments revealed indeed an asymmetry of the expected order of magnitude. Adding together the counts of the chamber which lay in the direction of motion of the disc, we get 11,100 particles against 10,644 for the corresponding sum of the counts in the other chamber. The observed difference is, therefore, 4·2 per cent, with a probable error of one per cent. When comparing this value with the beforementioned theoretical value of 10 per cent, we must take into account that only part of the counts was really due to the action of slow neutrons. By screening off the slow neutrons by means of a cadmium plate, the number of counts was reduced to about one half; these remaining counts were probably partly due to fast neutrons, partly to the natural contamination of the chamber. The result of the experiment may, therefore, be taken as evidence that the main part of those neutrons which are strongly absorbed in cadmium have very nearly thermal velocities.

In conclusion, we would like to thank Prof. J. Franck for many stimulating discussions.

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E. T. SØRENSEN.

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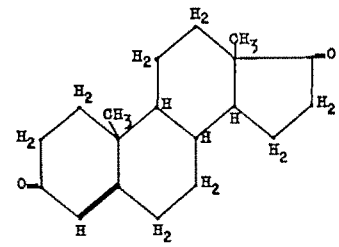
[1] Experiments with a similar arrangement, but yet on slightly different lines, have recently been performed by Amaldi, d'Agostino, Fermi, Pontecorvo and Segrè, *La Ricerca Scientifica*, vi, 1, No. 11–12.

Activity of Androstendione on the Sexual Organs of the Male Rat

It has repeatedly been stated that the relation between the results of capon test and rat test varies with preparations having male hormone action[1,2]. A definite number of capon units, applied in the form of testicular extracts, has a stronger activity on the sexual organs of the male rat than pure androsterone or hormone fractions from male urine. Gallagher and Koch[2], moreover, showed that boiling alkali destroys the hormone action of testicular extracts only, but not of the urine extracts. In fact, androsterone and *trans*-dehydro-androsterone, the existence of which in the urine has been described by Butenandt, are not altered by treatment with alkali.

Recently, L. Ruzicka and A. Wettstein have prepared *trans*-dehydro-androsterone from cholesterol and transformed it by oxidation into androstendione of melting point 173°–174°. Like corpus luteum hormone, it is an unsaturated diketone, and has the following formula:



It is now well known that the boiling of corpus luteum extracts with alkali destroys the hormone action. L. Ruzicka and A. Wettstein therefore recently suggested that androstendione or analogous compounds might be responsible for the peculiar action of the testicular extracts.[3]

As Ruzicka and Wettstein have already reported, the capon unit for androstendione and likewise for the saturated androstandione amounts to about 100 γ, according to the 6-day test used in this

laboratory. These substances are therefore somewhat less active on the comb than androsterone (60 γ), and particularly the diol (15 γ) obtained by hydrogenation of androsterone. In the meantime, I have examined these and related compounds also on the young castrated male rat. The first experiments have already shown that androstendione influences the seminal vesicles much more strongly than androsterone. In the following table, the results of a further series of experiments are shown, daily doses of 50 γ, 100 γ and 200 γ of the different preparations having been administered:

	Capon unit	Weight of the seminal vesicles in mgm.			Weight of the penis in mgm		
	γ	50γ	100γ	200γ	50γ	100γ	200γ
Androstendione	100	25	51	285	85	100	150
Androstandione	100	16	27	51	57	89	92
Androsterone	60	11	14	17	46	60	65
Diol	15	14	25	40	68	89	98
Diol-monoacetate	15–20	18	—	—	64	—	—
Diol-diacetate	15–20	18	—	—	60	—	—

The rats were castrated at a weight of 70–80 gm., and only used 4 weeks after the castration. They received the above-mentioned doses once daily for 20 days. On the twenty-first day the animals were killed and the seminal vesicles and penis weighed. The weights of these organs at the beginning of the experiment were about 6 mgm. and 50 mgm. respectively. Three to ten animals were used for each experiment.

The table clearly shows the high activity of androstendione on the seminal vesicles and the penis. The increase of weight of the seminal vesicles amounts, for example, with a dose of 50 γ to three times, with a dose of 100 γ to five times and with a dose of 200 γ to twenty-three times that of the androsterone animals. Also androstandione of m.p. 132° shows a considerable activity on the sexual organs of the rat, similar to that of the diol. In this connexion it must be remembered that A. Ogata and S. Hirano[4] report the isolation of an active substance of m.p. 129° from testicles, which may perhaps be identical with androstandione. The testosteron recently described by David, Dingemanse, Freud and Laqueur[5] of m.p. 154°–154·5° resembles more the diol in its activity. The fact that androstendione, even in the absence of the substance *X* postulated by Laqueur and his co-workers, and in spite of its rather moderate activity on the capon comb, influences the sexual organs of the young male rat to an extraordinary extent, gives further support to the hypothesis of L. Ruzicka and A. Wettstein that androstendione, or a similar unsaturated ketone like 3-keto-17-hydroxy androstene, may be identical with the less stable male hormone or hormones of the testis.

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July 9.

[1] Laqueur und Münch, *Ber. ges. Physiol.*, 61, 3-4; 1931. Matsuzaki, *Jap. J. Med Sci.*, 7, No. 1; 1934. Dingemanse, Freud und Laqueur, NATURE, 135, 184; 1935.
[2] Gallagher und Koch, *Endocrinology*, 18, No 1, 107; 1934. See also A. Ogata and S. Hirano, *J. Pharmac. Soc Japan*, 53, 153; 1933.
[3] L. Ruzicka and A. Wettstein, *Helv. Chim. Acta*, 18, 986; 1935.
[4] A. Ogata and S Hirano, *J. Pharmac Soc. Japan*, 54, 199; 1934
[5] David, Dingemanse, Freud and Laqueur, *Hoppe-Seyler's Z. physiol. Chem.*, 233, 281, 1935.

A Crystalline Fluorescent Dehydrogenation Product from Vitamin B_1

THE production of fluorescent solutions on oxidation of vitamin B_1 (antineurin) has been indicated in these columns by Peters[1], but no crystalline fluorescent product has hitherto been reported.

An alkaline solution of potassium ferricyanide transforms the vitamin hydrochloride ($C_{12}H_{18}ON_4SCl_2$) into a pale yellow, sulphur-containing compound (crystals m.p. 221°, from chloroform) having, in neutral or alkaline solution, an intense blue fluorescence; it possesses all the recorded properties of the 'thiochrome' ($C_{12}H_{14}ON_4S$) of Kuhn and his colleagues[2], including a similar absorption spectrum. This result is to us the more interesting, as thermal decomposition of the vitamin also yields a blue fluorescent compound[3], $C_9H_{10}ON_4$, which may have a related constitution.

G. BARGER.
F. BERGEL.
A. R. TODD.

Department of Medical Chemistry,
University of Edinburgh.
July 31.

[1] NATURE, 135, 107; 1935.
[2] R. Kuhn, Th. Wagner-Jauregg, F. W. van Klaveren and H. Vetter, *Z. physiol. Chem.*, 234, 196; 1935.
[3] G. Barger, B. C. P. Jansen, and A. R. Todd, *Chem. and Ind.*, 54, 596; 1935.

A New Alkaloid of Ergot

SOME years ago, Chassar Moir[1] demonstrated by clinical experiments that aqueous extracts of ergot, so far from being valueless as maintained by pharmacologists, contain an oxytocic principle with a remarkably rapid action on the human puerperal uterus. This principle was isolated by Dudley and Moir[2] and found to be a water soluble alkaloid, which they named ergometrine. During the process of manufacture of this alkaloid, we have isolated in addition a new alkaloid which is isomeric with ergometrine and convertible into it. The relationship is apparently similar to that existing between the alkaloidal pairs ergotoxine–ergotinine and ergotamine–ergotaminine. We have accordingly named it ergometrinine. In the above-mentioned pairs, one member in each case is comparatively inert. Whether the new alkaloid has the same clinical action as ergometrine or is a relatively inert isomeride remains a question for clinical investigation.

Ergometrinine has the formula $C_{19}H_{23}O_2N_3$. It is fairly soluble in chloroform and has $[\alpha]^{20°}_{5461} = +520°$ (in chloroform $c = 1$). It decomposes at about 195°. It forms a crystalline nitrate $B.HNO_3$, hydrobromide, $B.HBr$ and an acid sulphate $B.H_2SO_4$. The salts are easily soluble in water and give dextrorotatory solutions.

It is of interest to recall that ergine[3], $C_{16}H_{17}ON_2$, a degradation product of the ergot alkaloids, has a high optical rotation, $[\alpha]^{20°}_{5461} = +598°$ (in chloroform $c = 1·5$) similar to that of ergometrinine, and it seems probable that the latter has the same configuration.

S. SMITH.
G. M. TIMMIS.

Wellcome Chemical Works,
Dartford.

[1] *B.M.J.*, 1, 1119; 1932.
[2] *B.M.J.*, 1, 520; 1935
[3] Smith and Timmis, *J. Chem. Soc.*, 763, 1543; 1932. 674; 1934.

Expansion of Films of Myosin on Potassium Lactate

BY suitable manipulation, it has been found possible to spread true monolayers of proteins on various substrates. These monolayers can be examined both in the Langmuir trough and by the method of surface potentials. In the course of an investigation on the properties of monolayers of myosin, it has been found that when this protein is spread on potassium lactate at *p*H 7, it assumes a much more expanded form than it does on potassium chloride and other neutral salts, at the same normality and *p*H. It is interesting to note that it is a hydroxy-acid which causes this expansion, as neither acetates nor propionates are effective; the extension is noted, although to a less degree, with tartrates.

Furthermore, on lactate, as the substrate increases in alkalinity, the film assumes an even more expanded form, whereas no such change is noticeable with potassium chloride. The effect seems to be specific in regard to myosin, for egg albumin shows no such difference.

In the accompanying table are given the approximate values for the area occupied by a gram of myosin on various substrates, and the phase boundary potential difference caused by the film.

*p*H	Substrate	ΔV max (millivolts)	Area per gram (square metres) (1) At commencement of uniformity of the monolayer	(2) At the point of maximum phase boundary potential
7	*M*/2 Potassium chloride	275	525	310
7	*M*/2 Potassium lactate	160	1450	600
10	*M*/2 Potassium lactate	160	2200	1000
4	*M*/2 Potassium lactate	170	1300	250

These facts may be interpreted as indicating a tendency of the myosin to extend in the presence of lactate ions. The role allotted to lactic acid at the present time in the physiology of muscle is admittedly a subordinate one, but it is certainly interesting to find that the lactate ion and the contractile substance have this mutual relationship. If the lactate does take any active part in the cycle of events during contraction, it might conceivably be that of facilitating an active relaxation of the fibrils during recovery.

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Molecular Orientation and the Probability of Dissociation of Molecules by Electron Impact

HYDROGEN when bombarded by electrons with energy greater than 27 e.v. dissociates according to the following scheme:

$$H_2 \rightarrow H_2^+ + e \rightarrow H + H^+ + e + \text{kin. energy}^1.$$

In such a case, the dependence of the probability of the process upon the molecular orientation toward the electron beam will be shown in the angular distribution of the dissociation products, for they fly apart swiftly (at a velocity of 7–11 volts) along the line in which the molecular axis lay at the moment of excitation; strictly, however, a small deviation caused by the translational and the rotational motion must be considered. Our recent measurement of this distribution shows conclusively that the probability increases rapidly as the molecular axis approaches, from the perpendicular position, that parallel to the electron beam.

In Fig. 1*a*, hydrogen molecules stream downward from the jet *A* to be bombarded by 86-volt electrons in a horizontal broad thin beam, so that the sheath of ionisation is sufficiently widespread over the hole *B*. Positive ions the direction of which is defined by the hole and the twin slits of the shield (Fig. 1*b*) are received by a Faraday cage maintained at − 112 volts against the shield. The receiving system can be rotated around the cylinder axis. As the arrangement is of such high cylindrical symmetry, any deviation from a circle of the polar diagram of the current flowing into the Faraday cage indicates the dependence of the probability of ionisation or dissociation upon the molecular orientation.

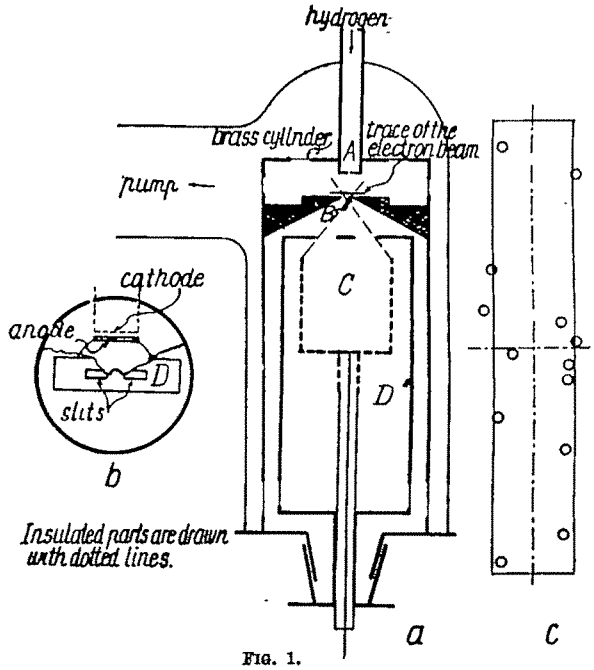

FIG. 1.

Fig. 1*c* shows the actual diagram obtained, its longer side being parallel to the electron beam. The electrostatic field due to the electron beam and ions[2] and the possible ionisation inside the shield by the scattered electrons with unequal angular distribution[3] are contrary or insufficient to produce the distortion of the diagram observed. Actually, an almost perfect circle was obtained with mercury vapour which filled the ionisation chamber uniformly. Molecular ions simultaneously formed will hit the part between the two slits of the shield. Another type of ionisation: $H_2 \rightarrow 2H^+ + 2e$, is much less frequent[1].

A similar investigation of the dissociation process through the state is in progress.

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[1] Bleakney, *Phys. Rev.*, 35, 1180; 1930. Loxier, *ibid.*, 36, 1285; 1930.
[2] Arnot, *Proc. Roy. Soc.*, A, 129, 361; 1930.
[3] *idem*, *ibid.*, A, 133, 623; 1931. Brode, *Rev. Mod. Phys.*, 5, 274, 1933.

Influence of a Magnetic Field on the Viscosity of Para-Azoxyanisol

IT is known that a magnetic field has an influence on the orientation of the molecules in anisotropic liquids[1]. As it seems probable that the coefficient of viscosity of these substances will depend on whether, and in which direction, the molecules are orientated, a magnetic field may be expected to influence the value of the viscosity coefficient. The first experiments on this subject were made by M. W. Neufeld[2], who investigated the influence of a magnetic field on the velocity of flow of anisotropic liquids (*p*-azoxyanisol and anizaldazin) through a capillary tube. But, as is well known, in a layer of anisotropic liquid so thin as that in the capillaries used by Neufeld (diameter 0·09 mm.), the action of the field may be impeded by the directive action of the walls. Consequently, Neufeld's experiments cannot be regarded as definitive.

In order to examine the question further, I applied a method in which thicker layers of liquid were in motion, and the surface of friction was a plane, so that it was possible to introduce a magnetic field perpendicular to this plane. This method is somewhat similar to that used by Quincke[3] for measurements of the influence of an electric field on the viscosity of liquids.

On one side of the beam of an analytical balance, a glass plate, 48 mm. × 24 mm. × 0·8 mm., was hung in a vertical plane. The plate was immersed in the liquid under investigation, the liquid being in a vessel having two parallel walls 6 mm. apart. The vessel was placed in a thermostat between the poles of an electro-magnet. Thus the plate could oscillate vertically in its own plane. The period of the oscillations was about 5 sec.; the maximum amplitude was 0·5 cm. The damping of such oscillations depends upon the viscosity of the liquid in which the plate is immersed. So far, the influence of the density of the liquid on the damping has been neglected. The apparatus was calibrated with sugar solutions, and then the measurements with *p*-azoxyanisol were made. Its temperature was 125° C. (anisotropic-liquid phase). The damping of the oscillations of the plate was measured without and with the magnetic field (2,400 gauss) perpendicular to the plate. The experiments have shown a rather unexpectedly great influence of the magnetic field on damping. From the values of the logarithmic decrements, the viscosity coefficients were determined, and it has been found that the viscosity in the magnetic field is about 3·5 times greater than without the field. This effect disappears completely after the transition to the isotropic-liquid phase (at a temperature of 135° C).

The experiments are being continued in order to examine how far this effect depends on temperature as well as on the direction of magnetic field. Other substances in their anisotropic-liquid phase are now also under investigation, and the results will be published shortly.

I wish to express my best thanks to Prof. M. Jeżewski for his helpful interest in these experiments.

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[1] See, for example, M. Mięsowicz und M. Jeżewski, *Phys. Z.*, **36**, 107; 1935. M. Trautz und E. Froschel, *Ann. Phys.*, **22**, 223; 1935.
[2] M. W. Neufeld, *Phys. Z.*, **14**, 645; 1913.
[3] G. Quincke, *Wied. Ann.*, **62**, 1; 1897.

Philosophy and Modern Science

WHEN Dr. Dawes Hicks wrote in his first letter[1] of "that which is sensed", I could not be sure whether he meant an external object, a light wave, or a Russellian sense-datum; but it appears from his further letter[2] that he meant none of them, but something much more like what I call a sensation. The patch of colour and my awareness of it seem to me to form an inseparable whole; I cannot imagine either without the other, and in any event it is only sensations which we are aware of that can form any basis of knowledge, and therefore that are relevant for my purpose. I do not deny the mental component in a sensation, but I do say that the recognition of physical and mental components in its structure is the result of inference and not a direct observation. Of course I agree fully that discrimination and comparison follow immediately on sensation; their nature is what I am trying to elucidate.

The word "universals" was not introduced by me, but by Dr. Hicks in a definition of "concept" that I do not accept; and the statement that numbers are not existents implies a restriction on the meaning of "existence", about the utility of which there might be a good deal of argument. In Dr. Hicks's sense I am prepared to admit that Neptune may be neither a universal nor a concept; but that does not affect the fact that it is a concept in mine. I never said that an object was a generalisation or an idea of a class of objects; it is a term in a general law or laws that serve to summarise and predict sensations, and such a term is what I have called a concept. I am certainly not the first to use the word in that sense, and I know no other in common use that would express the same meaning.

Perhaps I should explain again that I am not discussing the correctness of any opinion about the nature of the external world or of the mind. I am discussing the nature of the foundations of empirical knowledge, including inference. My objection to most of the theories of science propounded both by physicists and by philosophers is that they postulate from the start a degree of knowledge that cannot possibly be primitive; they begin at the middle or the end instead of the beginning, and thereby fail to come to grips with the fundamental problems.

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[1] NATURE, **135**, 1035, June 22, 1935.
[2] NATURE, **136**, 183, August 3, 1935.

Phonemes

AT the recent International Congress of Phonetic Sciences, many of the papers contained discussions of 'phonemes' and 'phonology'. There were nearly as many definitions of a phoneme as there were papers, and nobody seemed to have any clear idea of what was meant by the term. The hope was expressed that perhaps the psychologists might be able to discover what a phoneme is. At the Congress dinner, one speaker compared the hunting of the phoneme to the hunting of the snark—with the difference that at least there was a snark. Apparently the phoneme was smiled out of existence. This, however, was not the fault of the phoneme, but of the hunters who failed to find it. The nature of language shows that phonemes do exist, and the successful study of language requires that they shall be found.

Abandoning all speculations concerning what we think we hear and concerning what printed words may be supposed to indicate, we approach the problem as if we had been born deaf and had never learned to read. We first make a collection of tracks of speech on sound films. One after another we find stretches of vibration of more or less homogeneous character. Each one of them was produced by an impulse of the speaker. Such an impulse we term a *speech sound*. The record we have before our eyes is the expression of such speech sounds and it is the only information we have about them. On comparing the records we find that groups of similar speech sounds can be formed. In this way we establish that spoken language consists of a succession of speech sounds, more or less overlapped, and that these speech sounds can be grouped on the principle of similarity. A term is needed to indicate any one of the speech sounds of a group; for this we use the word *phoneme*. A phoneme is not an average of speech sounds; it is one of a group of similar sounds without specification of which one it is. Such a sound can be indicated by a letter. In this way we get a phonetic alphabet that correctly represents spoken language.

Though deaf and unable to read, we can find the phonemes and are able to express them in numbers obtained by measurement. The same procedure might be useful in regard to other problems of language.

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Fibre-Forms in Animal Hairs

THE effect of steam on the fibre-forms of white fox guard hairs reported by Dr. R. O. Hall[1] appears to be an example of a phenomenon, of very general occurrence in wool fibres, which has been described by me in connexion with fibre-forms in merino wool[2]. In the fleece this wool has a waviness which is, to a first approximation, sinusoidal, but the wave form is not entirely stable at ordinary humidities in single fibres withdrawn from the locks, so that in the natural state the fibres must be in a condition of strain, engendered, it may be, during the passage of the potentially curly fibre up the shaft of the follicle, or perhaps due merely to the closeness of packing of the fibres in the locks. The change in the form of a single fibre which proceeds slowly at room humidity is greatly accelerated when the fibre is wetted; it is an elastic deformation, and not a swelling phenomenon, since it is irreversible, and it may be resolved into torsional and flexural changes of which the former are more important. The obvious interpretation of the effect is that in the fleece the fibres have 'cohesive set' which is not relieved naturally because the closeness of packing and greasiness of the fibres in the locks preclude any readjustment under the action of atmospheric moisture.

After reaching an equilibrium form in cold water vapour, the fibre may change its configuration still more if the temperature is raised, and this final change may be compared with the effect obtained by Hall. In view of the fact that the merino wool fibres have existed in a state of strain in the presence of an alkali (the 'suint') the most natural explanation of the temperature changes is that in the fleece the fibres have not only 'cohesive' but also 'temporary' set[3,4], this being stable in cold water but not in hot water or steam. It will be seen that this is also a possible explanation of the flexural changes in steamed fox hairs; in them, of course, any cohesive set would be relieved naturally, since the hairs in the pelt are relatively free from mutual impedance. From this point of view Hall's highly curled hairs are in their normal, unstrained configurations, whilst the fibres in the pelt are temporarily set in straighter forms.

It may be, although this does not seem very probable, that any flexural changes occurring in steamed hairs are due to differential super-contraction following strain in the presence of an alkali; differential super-contraction would also be effective if, as is conceivable, there are structural faults of such a nature that the keratin on one side of the fibre is deficient in those lateral linkages which are responsible for the stability of normal α-keratin in steam. 'Weathering', therefore, must only be regarded as one of a number of possibilities.

The interpretation of effects of this kind is of considerable importance biologically, since the study of fibre-forms can only lead to a knowledge of the mechanism of growth if those factors acting after keratinisation is complete have been taken into account. Whether the cause of Hall's effect is really 'weathering' is, therefore, worth determining; tests on fibres from the pelts of very young foxes would probably throw light on the question.

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[1] NATURE, 136, 28, July 6, 1935.
[2] Woods, *J. Text. Inst.*, 26, T93; 1935.
[3] Woods, NATURE, 132, 709; 1933.
[4] Astbury and Woods, *Phil. Trans. Roy. Soc.*, A, 232, 333, 1933.

Effect of Pressure of Atmosphere on Development of Red Clover

SINCE 1932, studies in this laboratory have investigated the effect of partial pressures of various gases on the nitrogen fixation process in inoculated leguminous plants. The results, which throw considerable light on certain properties of the mechanism employed in this biological process, will be reported in detail in a future publication. In connexion with this research, observations which may be of general interest were made on the effect of growing clover under a fairly wide range of atmospheric pressures. Little work appears to have been reported on this aspect of plant physiology; discussion of the effect of gas pressures in most texts is restricted to the effect of partial pressures of oxygen and carbon dioxide in short-time experiments.

In these studies, red clover plants were grown from two to three months in 10 litre pyrex serum bottles on a sand substrate provided with the required plant nutrients (Crone's solution) and kept under pressures ranging from 0·12 to 1·8 atmospheres. Each bottle was provided with a mercury manometer (with trap) to measure the desired pressure; carbon dioxide was added as required by a method previously described[1]. Three times a week all bottles were aerated for 30 minutes and the pressures adjusted, thus preventing an accumulation of oxygen from the carbon dioxide decomposed in photosynthesis.

The most surprising feature of the study was the relatively good growth made by the plants over the entire range of pressures used; differences were noted, but in general, all plants developed even at the extremes of pressure. At pressures greater than atmospheric, nitrogen gas was used to increase the total pressure; the growth of the plants appeared to be quite normal and indistinguishable from plants grown in air. At pressures less than atmospheric and greater than 0·20 atm., a definite stimulation of plant development was noted. The leaves were larger and broader and the plants were slightly greater in size (dry weight) than the control plants kept at normal pressure.

Pressures below 0·20 atm. usually caused some inhibition of growth, probably due to low pressures of oxygen. Previous studies of the effect of pO_2 indicated that plants kept in atmospheres in which the pO_2 becomes less than 0·05 atm. develop typical signs of carbohydrate excess, namely, red stems, yellow leaves and stalky growth habit. Root development under these conditions is characterised by tuberisation. Responses similar to these were observed in plants grown under low total pressure and hence low pressure of oxygen.

Occasionally freak growths were encountered in plants grown under low pressures, including false nodules on the roots, long and pointed leaves and, more rarely, four and five leaves instead of the usual three. Similar studies with other species might be of value in interpretation of types of plant growth at different altitudes.

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[1] E. M. Smyth, *Science*, 80, 294; 1934.

Celluloid Tubes for Sampling Cores of Deep Sea Mud

IN recent years, there has been considerable progress in obtaining long cores of deep sea mud in the course of oceanographical and limnological work. Analysis of the stratification of these cores frequently gives valuable geological, geochronological and palæoclimatological results. During deep sea investigations it is possible—at least in the U.S.S.R.—to secure cores four to five metres in length. The preservation and subsequent examination of these cores present, however, some difficulties, due to the necessity of pushing out the obtained core from the Ekman tube, the *Meteor* type of sounding tube, and the glass container. This operation is often followed by the secondary deformation of the core, and includes other difficulties of minor importance.

The use of glass containers permits the cores obtained to be kept for a long time in a humid and undisturbed condition. Recently it has been found practicable to remove the cores from metallic tubes in such containers on board ship (Dr. Kuenen[1] on board the *Willebrord Snellius*). This may be ascribed to the fact that the glass container, being placed inside the Ekman or the *Meteor* type tubes, narrows the opening of such a tube, and consequently the length of core is considerably diminished. Dr. Kuenen's method, however, causes the deformation to be greater, and even doubled.

Instead of glass containers we have used brass ones, with thin walls, that have been placed in tubes of the *Meteor* type or simply adjusted to their stopper. They are not transparent, however, and in using them the process of subsequent withdrawing of cores for their further examination is quite unavoidable. Glass containers, in spite of their transparency and non-oxidisability, have necessarily thick walls and are very fragile and heavy.

In connexion with these difficulties, I venture to suggest that celluloid or some other transparent plastic material be used for the preparation of containers to secure deep sea mud. These containers could have very thin walls (0·2–0·3 mm. or less) and would possess many following advantages: they would be cheap, light, transparent and chemically inactive; moreover, the core could be withdrawn by cutting the container along its length. The thin walls of the suggested containers would make it possible to use them inside the Ekman or *Meteor* type tubes without diminishing the size of the openings. The core included in such a container could be divided into vertical or horizontal sections, even without having to be withdrawn from the container.

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[1] Kuenen, H., Die Viermeter-Lotrohre der *Snellius* Expedition. *Ann. der Hydrogr. u. Marit. Meteorol.* H. III, 1932. See also: Stetson, H. C., The Bottom Deposits, Sci. Results of the *Nautilus* Expedition, 1931. Papers in Phys Oceanogr., etc., vol. 11, No. 3 P.V. 1933. Camb. Mass.

Symbiotic Association between Flies and Nematodes in Galls of Eucalyptus Trees

GALLING of the flower buds of certain trees in Australia, notably *Eucalyptus rostrata* and *E. hemiphloia*, is sometimes so heavy that no flowers appear, and no honey harvest is reaped. The chief causes of galling are agromyzid flies of the genus *Fergusonina*, Malloch.

Inside the galls the fly larvæ are associated with small nematodes, which I have placed in a sub-genus of the plant-parasitic genus *Anguillulina*. The nematodes live in the gall-cavity in contact with the fly larvæ, and ultimately a number of fertilised females enter the body-cavity of the female larvæ of the fly. There eggs are laid, and when the female fly in turn deposits its eggs in young flower buds a number of larval nematodes accompany them. The nematodes at once feed on the plant tissues and give rise to proliferating cells on which the fly larvæ feed, making hollows in which they are associated with the worms.

The symbiosis appears to have arisen as an accidental association between agromyzid leaf-tunnelling larvæ and plant parasitic nematodes.

Goodey[1] has described a parasitic association between the frit-fly of oats and a nematode, which may correspond to one of the steps in the evolutionary series which led to the highly organised association outlined above.

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[1] *Phil. Trans. Roy. Soc.*, B, 218, 315; 1930.

Absorption Spectrum of Methyl Iodide

THE excited state or states, designated by Mulliken as $^{1,3}E$, that are concerned in the ultra-violet absorption continuum of methyl iodide, have been compared with the $^{1,3}\Pi$ states of the ICl molecule[1]. The absence of a band system accompanying the continuum has led to the assumption that the upper state is unstable, whereas a comparison with the $^3\Pi$ states of I_2, IBr and ICl suggests that a ^3E state of CH_3I might possibly have a potential curve with a shallow minimum, and that there might exist a band system the convergence limit of which would occur at a wave-length much longer than that of the absorption maximum near λ 2600. The discovery of such a convergence limit would have the additional interest of providing an accurate value of the energy of the C–I bond.

To test this possibility, the absorption spectrum of gaseous methyl iodide at 220 mm. pressure was photographed through an absorption tube 6·6 metres long, the methyl iodide having been fractionated twice immediately before use. No bands were found; but the continuous absorption was found to extend practically to λ 3600, which is some distance beyond the absorption 'limits' of λ 3360 and λ 3100, found by Iredale and Mills[2] and by Hukumoto[3] respectively, using columns of gas 1 metre long. Although the conditions in the long absorption tube made accurate intensity measurements impossible, it was found that the absorption limits in equivalent columns of gaseous and liquid methyl iodide (6·6 metres at 220 mm. and 0·6 cm. respectively) occurred at about the same wave-length, indicating that the absorption coefficients of liquid and gas in this region are of the same order of magnitude. Since Iredale and Wallace[4] found that 4 cm. of the liquid absorbed as far as λ 3950, a result that was confirmed in this laboratory, an equivalent column of the gas of the rather impracticable length of 40 metres should absorb at wave-lengths considerably longer than λ 3600, so that the existence of a band system in this region, though improbable, cannot be entirely ruled out.

The experiments also emphasise the fact that the determination of absorption limits by extrapolation from results obtained with short columns of gas may lead to values which are in error by many hundreds of Angstrom units, and that results so obtained have no thermochemical significance.

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[1] Mulliken, *Phys. Rev.*, 47, 415; 1935.
[2] Iredale and Mills, *Proc. Roy. Soc.*, A, 133, 430; 1931.
[3] Hukumoto, *J. Chem. Phys.*, 3, 164; 1935.
[4] Iredale and Wallace, *Phil. Mag.*, (7), 8 1093; 1929.

Points from Foregoing Letters

Prof. G. Beck discusses the forces binding the constituent parts of the nucleus of the atom and inquires into the reasons why two electrons are not emitted simultaneously in radioactive changes; he considers that this would involve the simultaneous occurrence of two neutrinos (neutrino and antineutrino).

The half-life periods and the maximum energy of the electrons emitted by a number of artificial radioelements obtained by neutron bombardment are given by Prof. A. I. Alichanow, A. I. Alichanian and B. S. Dželepow. The authors point out that their findings do not agree with Fermi's theory of beta ray decay and do not fit in Sargent's diagram, which connects the maximum energy of emitted electrons with the disintegration constant.

In order to determine the velocity of slow neutrons, Dr. O. R. Frisch and E. T. Sørensen have investigated the effect of passing the neutrons through the marginal part of a rotating wooden disc, and observing the effect of the emerging neutrons upon boron-lined ionisation chambers at two different angles; the results indicate that a large part of the neutrons have velocities of the order of 200 metres per second, and further experiments with cadmium screens show that the main part of those neutrons which are strongly absorbed in cadmium have such thermal velocities.

Dr. E. Tschopp finds that androstendione surpasses other known male hormones in its action upon the growth of the sex organs of the male rat, though, as is the case with the testicular extract, its effect upon the growth of the capon's comb is inferior to that of androsterone. This and other evidence supports the view that androstendione is a constituent of the male hormone of the testes.

Thin films (mono-molecular) of myosin, a constituent of muscle protein, floating upon water solution, are expanded by potassium lactate at *p*H 7, and the expansion increases at higher *p*H (alkaline solutions). A. A. Moss, Jr., Prof. Eric K. Rideal and E. C. Bate Smith consider that these phenomena may throw some light on the changes which take place in the muscle, the lactate helping in the relaxation of the fibrils during recovery.

Hydrogen molecules are more readily dissociated by the impact of electrons moving parallel to the molecular axis, according to Prof. N. Sasaki and T. Nakao. The authors give a diagram of the apparatus used in measuring the angular distribution of the resulting ions.

The influence of a magnetic field upon the viscosity of an anisotropic liquid (*p*-azoxyanisol at 125° C.) has been re-determined by M. Miesowicz, from the damping effect upon an oscillating plate. He finds that the viscosity is increased 3·5 times by a magnetic field of 2,400 gauss.

Clover plants have been grown by Prof. P. W. Wilson in a closed system under pressures of 0·12–1·8 atmospheres. At pressures greater than atmospheric the development of plants appeared to be normal; between 0·20 and 1·00 atmosphere, stimulation of growth was evident. Below 0·20 atmosphere, development was restricted, apparently because of low pressures of oxygen available. At extremely low pressures occasional freak growths were encountered.

N. S. Bayliss describes the ultra-violet absorption spectrum of methyl iodide, photographed through 6·6 metres of the gas. The continuous spectrum was found to extend to at least λ 3600, and although no accompanying band system was found, the possibility of one cannot be entirely dismissed.

Research Items

Excavation in Brittany

IN 1929 Sir Robert Mond was invited to undertake the exploration of the Tressé *allée couverte* by Baron Robert Surcouf, its owner, and entrusted the work of excavation to Miss V. C. C. Collum. This megalithic monument is situated in the Forêt du Mesnil, Ille-et-Vilaine, and had not previously been explored, although it had been reported in 1880 and then scheduled as an ancient monument. Excavation took place in April 1931, and an account of the results then obtained has now been published ("The Tressé Iron-Age Megalithic Monument (Sir Robert Mond's Excavation)". By V. C. C. Collum. Pp. xii+123, with 35 pls. Oxford University Press. 10*s*. 6*d*. net). The objective of the investigation was to test the generally accepted view that megalithic monuments in Brittany, such as this, have suffered 'violation' and disturbance in an age long subsequent to that of their erection. Careful and detailed records of excavation and stratification, therefore, were made. A peculiar and characteristic feature of the monument is the occurrence of two double pairs of sculptured human breasts, one double pair on a transverse stone blocking the northern end of the *allée*, the other on the western upright of the alcove beneath the transverse stone. In brief, the results of the investigation indicate that this is a native Gaulish tomb erected in the first century A.D., probably in the reign of Domitian. Fragmentary skeletal remains, not cremated, associated with pottery, both wheel and hand-made, steatite beads, iron which may have been part of a fibula adorned with bronze, and 'nondescript' flint and chert implements, together with the representation of female breasts, point to burial offerings to the mother-goddess or female principle, of which the cult was widespread in Egypt and the East, and at the date suggested as that of the megalith, incorporate in Eastern mysticism. The cult, it is suggested, reached Brittany and Great Britain by way of the Mediterranean, North Africa and the Iberian coast.

Iron Age Pottery in Britain

DR. R. E. MORTIMER WHEELER appends to his report on the excavation in 1934 of Maiden Castle, Dorchester (*Antiquaries J.*, **15**, 3), an important, though provisional, amended classification of the Iron Age pottery of Britain. A previous classification, proposed by Mr. Christopher Hawkes, recognises three groups or cultures: *A*—composite, mainly Hallstatt, the type-site being All Cannings Cross; *B*—marsh-village culture of Glastonbury and Meare, pottery with elaborate curvilinear decoration, pre-eminently 'Celtic'; and *C*—Belgic immigrant culture, deficient in artistic expression, but technically well equipped, having the potter's wheel. Geographically, *A* is found over most of middle and southern England, and may be recognised so early as the sixth century B.C., remaining dominant in Oxfordshire, Kent and other south-eastern counties down to the first century B.C. In the west, it is replaced by *B* in the second century B.C., while the Belgic culture enters the south-east in the first half of the first century B.C. *B* occurs primarily in the south-west, but extends, on one hand, to Northamptonshire and Lincolnshire and, on the other, eastward into Sussex. There is no good evidence for *C* in Wessex before the beginning of the first century A.D. Provisionally, it is proposed to subdivide *A* into three parts: *A*1, 600–400 B.C., marked by finger-tipped ornament especially on high-shouldered *situla* types, and red-coated ('hæmatite') bowls, at first with rilled, and later with cordon decoration; *A*2, 400–200 B.C., absence of above types and presence of poor derivatives of *situla* type, coarse, rough but light fabric, no decoration (well represented at Maiden Castle); *AB*, 200 B.C. to early first century, smaller and simpler types of *A*2, with pottery of *B* types. Class *B*, hitherto regarded as synonymous with Glastonbury, is now seen to be a complex of two or three elements of diverse origin. Decoration is not an adequate criterion. In its place is suggested the bead rim and the counter-sunk handle, neither of which occurs in *A*. The Belgic pottery does not reach Maiden Castle until the eve of the Roman conquest. Reproduction of modified *B* types with the aid of the potter's wheel suggest a composite culture *BC*.

Inbreeding of Swine

VARIOUS experiments on inbreeding of pigs have led to the conclusion that it is injurious to the race. In an experiment which has been continued for eight generations by Mr. R. E. Hodgson (*J. Hered.*, **26**, No. 5) at the Experiment Station of the University of Minnesota, he reaches somewhat different conclusions. Brother-sister matings of registered Poland-China swine were made for eight generations without any marked loss of vigour. The strains chosen appear to have been exceptionally free from deleterious recessive characters. The experiments began with six sows, the strain from one being used as an out-bred control. Three of the inbred lines were lost in the first generation and a fourth in the second generation, due to reluctance to mate. In 1926 two new lines were started, one of which is now in the sixth and the other in the eighth inbred generation. The difficulty in securing matings has been less since the fifth generation, and it appears that the strains can now be propagated indefinitely by brother-sister mating. A few anomalies have appeared, and some undesirable characters were segregated, including odd psychological and physiological sexual reactions. Evidence was obtained that differences in disposition, such as super-docility and wildness, are inherited. A substrain with yellow and another with white blotches was segregated from one line. Comparison with the non-inbred strain indicates that no vigour has been lost, but that segregation of vigour has taken place in some cases.

Seasonal Variation in Oogenesis of a Hermit-Crab

M. K. SUBRAMANIAM (*J. Roy. Micr. Soc.*, **55**, Pt. 1; 1935) has studied the oogenesis of a hermit crab, *Clibanarius olivaceus*, found in brackish water at the mouth of the Adyar River, near Madras. In January and February, after the heavy rains of the retreating monsoon, the sea-water mixes freely with the river-water, and the bar at the mouth of the river is

open. From the middle of March the level of the water in the river begins to fall, with consequent widening of the bar, and in early April the sea invades the river only at high tide, and even this ceases by mid-April. The crab was found to breed throughout the year but especially in the period from September to March. The ovaries were removed and carefully preserved, and the oocytes examined. In January and February the oocytes showed a voluminous formation of fatty yolk and the occurrence of albuminous yolk. From April to June there was less fatty yolk in the oocytes but more albuminous yolk. The author states that during the period from November to the middle of April, the salinity of the estuarine water is high, but later, as the bar closes, the salinity is suddenly lowered and there is a rise in the *p*H. The author supposes that the alterations in the condition of life of the crab may have led to a variation in the metabolism which may have affected the constitution of the oocytes.

Diseases of the Iris

A SHORT article by Mr. G. N. Bunyard, in the *Gardeners' Chronicle* for June 29, describes four diseases of Iris plants. Leaf spot, caused by the fungus *Heterosporium gracile*, and Leaf rust, *Puccinia iridis*, are two diseases of the foliage, and may assume serious proportions. Ammoniacal copper carbonate and potassium sulphide do not control either malady, but the simple routine of dividing the rootstock every second year gives healthy produce. Rhizomes and roots are subject to 'scorch' and 'rhizome rot', but no organism has yet been identified as the cause of either disease. Both may be controlled by lifting the rhizomes, cutting away the rotten parts, and then bathing the rest in a bright pink solution of potassium permanganate for twenty minutes. Planting in a 'hospital' bed containing peat and sharp sand further assists the progress of recovery.

Poisoning of Plants by Fluorine

ESCAPE of hydrofluoric acid during chemical operations in which ores rich in fluorides are treated with mineral acid is not easy to prevent, especially when steam is simultaneously liberated, and it may result in damage to the vegetation of the surrounding neighbourhood. An ingenious biochemical method of detecting poisoning of plants by the acid has been devised by Prof. Angelo Contardi in conjunction with Carlo Ravazzoni (*Rend. R. Ist. Lombardo Sci. e Lett.*, 68, parts 6–9). The method is based on the observations (1) that hydrofluoric acid, which attacks the leaves of plants, remains for a long time in the form of soluble compounds capable of inhibiting the enzymic action of the acid phosphatase of rice husk, and (2) that the insoluble fluorides normally present in leaves exert only a very feeble action on this enzyme. The aqueous extract of the leaves under examination is evaporated to dryness, ignited and fused with sodium carbonate, the cold mass being then dissolved in water and the solution filtered. A second solution is prepared similarly from normal, unpoisoned leaves of the same kind of plant, and the effects of the two liquids on the enzymic action are compared.

Respiration of Barley Leaves

THE relation between carbon dioxide production and the concentration of the various carbohydrates during starvation of isolated barley leaves has been investigated by E. W. Yemm (*Proc. Roy. Soc.*, B, 117, 483–525; 1935) using a combination of iodometric and modified Hagedorn-Jensen methods for the estimation of glucose, fructose, maltose and sucrose. Non-sugar impurities were determined separately after removing all the sugars by yeast fermentation. Carbon dioxide production shows a rise during the 12 hours immediately after isolation, and the subsequent rapid fall is interrupted after about 40 hours by a stage coinciding with the yellowing of the leaves. Finally, the respiration falls rapidly, concurrently with browning and death of the cells. No simple quantitative relation exists between the concentration of any individual carbohydrate and the rate of carbon dioxide production; and, moreover, it is only in the initial stages that all the carbon dioxide arises directly from the available carbohydrate. During the remainder of the time, as much as 75 per cent of the carbon dioxide production arises from some undetermined source other than carbohydrate, and this production is less when the initial sugar content is high, that is, progressive carbohydrate exhaustion increases the production of carbon dioxide from undetermined sources. Determinations of the respiratory quotient suggest that this carbon dioxide arises from protein breakdown. (A similar conclusion was reached by Dastur and Desai with rice seedlings, *Ann. Bot.*, 49, 53; 1935.) It is suggested that rapid sucrose hydrolysis is followed by glycolysis of fructose and accumulation of glucose, which disappears more slowly. Essentially similar results were obtained with bean leaves.

Grass Land Problems in South Africa

ANY traveller in South Africa must be impressed with the wide expanse of country, often comparatively high tableland, which is covered with a grassland dotted throughout with scattered trees, a typical savannah country. Botanically, such country is of the greatest interest as it always raises the question whether such a precarious balance between two types of vegetation will be maintained or whether the trees will close over and subdue the grass or the grass gradually choke out the trees. Economically also the problem is of the utmost importance, this balance of grass and trees being influenced by the head of game or by the amount of stock carried, and by the practice, or lack of regular practice, in seasonal burning of the veldt grasses. It is very fitting therefore that the new *Journal of South African Botany*, issued under the authority of the trustees of the National Botanic Gardens of South Africa and edited by Prof. R. H. Compton, director of the Kirstenbosch Gardens, should include in part 2 of its first volume, a very interesting general discussion of South African grassland problems by Prof. J. Phillips, of the University of the Witwatersrand. Under his direction, problems of grassland ecology are being attacked at the Botanical Research Station of the University at Frankenwald, in the high veld, and a preliminary study of the root systems of some of the characteristic high veld grasses, by Messrs. S. M. Murray and P. Glover, carried out at this station, is reported upon in the same journal. This study shows that very fundamental differences may be found in the root systems of pioneering species and other species; whilst Prof. Phillips's paper shows the very wide nature and great economic importance of the problem raised by the study of these grasslands.

Evaporation in India

AN investigation into evaporation in India has been made in the Agricultural Meteorology Branch of the India Meteorological Department by P. K. Raman and V. Satakopan. The work is described in Scientific Notes, 6, No. 61 (Delhi: Manager of Publications). As the authors remark, "our knowledge of evaporation from the soil under natural conditions is practically nil in India", and they have had to content themselves with a study of the evaporating power of the atmosphere with respect to a free water surface, and to calculate this from various meteorological factors such as mean wind velocity, mean relative humidity and mean water vapour pressure, by an empirical formula. The formula chosen was derived from a formula of Carl Rohwer based on laboratory studies made with the view of testing separately the effect of the different factors. In Rohwer's formula, a factor $e_s - e_d$ appears, where e_s is the mean vapour pressure of saturated air at the temperature of the water surface and e_d is the mean vapour pressure of saturated air at the temperature of the dew point. In the absence of data for the temperature of free water surfaces in India, the rather bold assumption has been made that calculation of mean values can be made as though the temperature of the water is the same as that of the air, which is possibly true when one is dealing with averages. In that case, $e_s - e_d$ becomes $(100/h - 1)\,e$, where h is the relative humidity of the air and e is its vapour pressure. Calculated means of evaporation for a well distributed network of stations for each month are tabulated, together with the mean monthly rainfall. The evaporation is shown cartographically on maps of India, also the annual evaporation and the annual figures for rainfall minus evaporation. As might be expected, the area of greatest evaporation is in the west of India, with its centre in about latitude 20° N.

Activation and Evaporation of Adsorbed Atoms

J. E. LENNARD-JONES and C. Strachan (*Proc. Roy. Soc.*, A, June 1) have made a wave-mechanical calculation of the probability of activation of adsorbed atoms, and Strachan in a second paper extends the calculation to obtain probabilities of evaporation of atoms from surfaces. The atoms adsorbed on a crystal lattice may remain in one place, vibrating about a mean position, they may migrate from place to place or they may be ejected from the surface by the heat motion of the lattice atoms. The vibrations of the atoms about a mean position provide the activated energy states which are considered in this paper. The atoms are assumed to be adsorbed as a simple cubic crystal and the forces holding them are supposed to be of the Morse type in which the potential is given by two exponential terms corresponding to a short-range repulsive field and a long-range attractive field. Formulæ are found for the probability of excitation of different excited vibrational states and for the average life of an atom in an excited state. The life of an excited state seems to be of the order of 10^{-12} sec. in a particular case—this time is a few periods of the vibratory atom. The migration of atoms over the surface takes place when the atoms are in an activated state. The evaporation problem involves an extension to the case of transitions to a state in the region of continuous energy distribution. The theory is worked out and applied to the cases of H_2, HD and D_2. The surface forces are nearly the same for these molecules; the different masses lead to different wave functions and the probabilities of evaporation from a surface at low temperature in these molecular species are roughly in the ratio 1, 0·2, 0·05.

A New Power Output Valve

IN the best types of modern broadcasting receivers, the output valve is usually of the triode or three-electrode type, since this enables the most complete freedom from distortion of the acoustic output to be obtained. This valve is, however, relatively insensitive, so that an additional stage of audio-frequency amplification is required, rendering its use uneconomic in the majority of commercial receivers. Such receivers therefore usually employ a pentode output valve, which will give the same output power for about one third of the input voltage required by the corresponding triode. The pentode output valve is very liable to produce distortion due to curvature of its characteristics over a considerable portion of its working range. This defect is claimed to have been removed in a new type of power output valve described by J. H. Owen Harries in the *Wireless World* of August 2. The new valve is of the four electrode type, the cathode and two grids being of normal construction and dimensions; the novelty lies in the fact that the anode is a cylinder of unusually large diameter. It has been found that if the anode of a multi-grid valve is spaced from the outer grid at a certain critical distance, the undesired secondary emission is eliminated, and the consequent necessity for a suppressor grid, as in the pentode, is avoided. Characteristics of the new valves in comparisons with those of typical pentodes illustrate the improvement which has been obtained in linearity and resultant freedom from distortion. The impedances of the new valves are lower than those of the equivalent pentodes, while the mutual conductances are appreciably higher, thus giving about the same overall sensitivity. It is stated that the High Vacuum Valve Co. is now manufacturing these new valves in a two-watt output type, which is considered to be adequate for the average domestic user.

Structure of a Stellar Atmosphere

W. H. CHRISTIE and O. C. Wilson (*Astrophys. J.*, 81, 426) have described an interesting method of examining the structure of a stellar atmosphere in the case of the eclipsing binary ζ Aurigæ. This system consists of a giant *K*-type component with a *B*-type companion, and the authors have devised a method whereby the effects of the light of the former may be eliminated from the composite spectrum, thus permitting a study of the light from the *B* star shining through the atmosphere of the *K* star. A series of spectra taken near the period of eclipse will thus give the relative heights to which various elements extend in the atmosphere of the *K* star, and also the relative number of atoms existing at different levels above the photosphere. Changes in the total absorption have been measured for nearly 100 lines in spectrograms taken at Mount Wilson during the 1934 eclipse, and the results grouped into the following six classes: neutral metals, Mg, Ti II (two groups), H, and Ca II. Accurate photometric observations are still badly needed to improve the values of essential factors such as the relative diameters of the two components and the inclination of the orbit. It is hoped that these will be forthcoming during the next eclipses in 1937 and 1939.

Tectonic Framework of China

PROF. J. S. LEE delivered a lecture before the Geological Society on June 5 on a subject of which he is the leading authority: "The Structural Pattern of China and its Dynamic Interpretation". Since the time of Suess, it has been generally accepted that the structural framework of eastern Asia consists of a series of arcs with the 'Amphitheatre of Irkusk' as their common centre. Modern researches, however, have shown that each of these arcs embraces features of different tectonic origin. Three main groups of structural elements are now recognised: (*a*) the Cathaysian geosynclines and their complementary geanticlines; (*b*) the east-west zones; and (*c*) the shear-forms. These seem to be fundamentally independent of each other, although they sometimes fall in line and sometimes interfere.

The Palæocathaysian geosyncline existed as an epicontinental trough, more or less parallel with the eastern border of the continent, so far back as late Pre-Cambrian time. A remnant of its borderland still remains in the coastal belt of south-eastern China. Prof. Lee traces its history to Permo-Carboniferous times, when it formed the eastern extension of the Tethys, and on to the Triassic when it formed the Mesocathaysian geosyncline. It was completely filled in during the Lower Jurassic, and since then China has remained continental. Modern features arose from Jurassic-Cretaceous movements and some of them followed the old-established lines, with the result that geosynclines and geanticlines of the Cathaysian type can still be recognised. One of the present-day troughs is occupied by the Sea of Japan and the Yellow Sea; another, farther inland, stretches from the plain of Manchuria to the Central Yangtze Basin and is named the Neocathaysian geosyncline.

The east-west zones, tabulated below, exhibit a rhythmic orogeny that is one of the most striking tectonic phenomena of eastern Asia. It will be noted that the interval between the ranges is 8° of latitude in every case.

The third group of features includes various shear-forms, of which three types predominate. One of these forms consists of a series of nearly parallel folds trending north-east or north-west and is known as the ξ type. These are commonly traversed by faults roughly perpendicular to the axes. Another consists of a frontal arc with a radial backbone, somewhat after the fashion of a bow and arrow, and is called the ε type. The third is a bundle of folds curving round an old massif or mountain mass and is designated the η type.

Orogenic Epochs	Ranges and their latitudes			
	Tannu-Kentai 49°–50°N.	Inshan 41°–42°N.	Tsingling 33°–34°N.	Nanling 25°–26°N.
Tertiary	—	×	?	?
Jurassic-Cretaceous	×	×	×	×
Hercynian	?	?	×	×
Caledonian	×	—	?	×
Pre-Sinian	×	×	×	×

Consideration of the mechanics, supported by experimental reproductions, leads Prof. Lee to the belief that the shear-forms imply horizontal shearing movements of the upper layer of the continental mass, directed on one hand against the Tibetan massif or the shattered ends of the east-and-west ranges, and on the other against the border of the continent. The other features also suggest southerly movement of the continental mass, and it is suggested that the driving force might have been supplied by an increased speed of rotation of the earth due, for example, to concentration of mass in the interior or to bodily contraction of the earth as a whole. An attempt is made to test the hypothesis by the distribution in time and place of the marine transgressions of the past, some twenty-one of which (major cycles) are recognisable since the beginning of the Cambrian. For a more extensive summary of the lecture, reference should be made to *Abs. Proc. Geol. Soc. London*, No. 1298, June 17, 1935.

Return of Mineral Elements to the Soil by Plants

IT is not generally known that plants can return to the soil at some stage of their growth, either after the first burst of vegetative activity or after maturation of the fruits, certain of the more important nutrient elements which they have absorbed.

Until recently the evidence was meagre, but a series of papers published in Bucharest by Prof. Deleanu and his colleagues[1–3] recording the result of investigations into the function of mineral elements in the life of the plant, has added considerably to our knowledge of this phenomenon.

In 1908 Prof. Deleanu himself[4] found that there was a reversal of the process of absorption of soil constituents, called by him 'negative migration', which occurred in oat plants after they had reached maximum growth, the loss being 64 per cent of the ash elements and 47 per cent of nitrogen. In 1919 J. S. Burd[5] recorded that with barley grown on two different soils, the initial progressively increasing rate of absorption of the soil constituents during the early stages of vegetative development was followed by a period of actual loss, coincident with the development of the heads, and succeeded by renewed absorption at a later period. The absorption and loss were most marked in the elements potassium and nitrogen. In maize the rate of absorption decreased considerably prior to head formation, though no actual loss of soil constituents was found[6]. Plants such as the potato, on the other hand, show no such striking change in the rate of absorption.

In the recent Bucharest investigations, V. G. Bossie[2], working with wheat, shows that the cycle of absorption and migration is somewhat similar to that of barley, differing only in details. The life period of some seventy days in wheat can be divided into three phases: (1) vegetative, which reaches its maximum by the twenty-sixth day; (2) fruiting, which commences about the thirty-first day and culminates about the sixty-fifth day, and (3) post-maturity. Absorption of all mineral elements in the aerial portions as a whole was rapid and very considerable during phase (1); thereafter the rate of absorption of phosphorus, nitrogen and magnesium was markedly decreased, but none of these was lost, whereas in the case of potassium and calcium actual loss occurred after the first twenty-six days; silica, which amounts to nearly half the total ash, continued to be absorbed more or less regularly until maturity, when some loss of all elements occurred. The amount of the loss was most marked in the case of potassium and calcium, as negative migration of these had started early, but the loss in all other cases was less than 20 per cent. What is happening is that during the stage (2) the developing ear is drawing its supplies of nutrients from the leafy stems, silica only being absorbed directly from the soil; the supply of nitrogen, phosphorus and magnesium is inadequate in the leaves and so a further slight absorption of these elements from the soil takes place; potassium and calcium, however, are in excess of the amount required by the ear, and so can be returned to the soil.

The phenomenon of negative migration occurs in other groups of plants. In tobacco, for example, not only does loss of soil constituents occur when the main stem has reached maturity, but it may also be succeeded by re-absorption and further negative migration corresponding with the development of axillary shoots[3].

It seems obvious, therefore, that the reason for the changes in the rate of absorption by the plant must be sought in the metabolic state of the tissues, and that when actual loss occurs it is probably due to the interaction of the factors causing the metabolic changes and the factors of the soil environment affecting absorption. In this respect it is well to mention that Burd[5] found that the losses occurred in oats when the constituents of the water extracts of the soil were at or approaching their minima and when the same constituents were moving from the leaves to the ear.

It has been suggested that the elements migrating from the aerial organs are accumulated by the roots. In the paper by Bossie, however, details of the analyses of roots have been included, and bearing in mind the difficulties attending collection of these organs from the soil, the results show that this cannot be the case; for example, from the twenty-sixth day to the thirty-fifth day, the aerial organs of a hundred wheat plants lost 0·187 gm. of potassium, whereas the roots only accumulated 0·001 gm. in the same time; the other 0·186 gm. must therefore have been returned to the soil.

N. L. PENSTON.

[1] Deleanu, N. T., and Bordeianu, C., *Acad. Roma. Mem. Sect. Stiint.*, Ser. III, Tom ix, Mem. 10 (1934), "Studiu asupra rolului si functiunii substantelor minerale si organice in viata plantei", No. 11.

[2] Bossie, V. G., *Lab. de Chim. Anal. Facultatea de Farmacie, ibid.*, No. iv; 1934.

[3] Vladescu, I. D., *Lab. de Chimie. Anal. Universitatea din Bucuresti, ibid.*, No. v; 1934.

[4] Deleanu, N. T., *Trav. de. l'Institut de Bot. Geneve*, 1908

[5] Burd, J. S., *J. Agric. Res.*, 18; 1919.

[6] Jones and Huston, *Ind. Expt. Sta Bull.*, 175, 1914

Third Imperial Mycological Conference

IN spite of financial stringency, which has cramped the activities of many scientific institutions of recent years, the Imperial Mycological Institute organised a very successful Conference at the Imperial College of Science and Technology in September 1934. Invitations were conveyed to overseas Governments of the British Empire, to certain Government Departments of the United Kingdom, and to the staffs of agricultural and horticultural research stations, university departments, to individual mycologists, and to the representatives of certain firms interested in the manufacture of fungicides. A report of the activities of this Conference has recently appeared (Imp. Mycol. Inst., Kew, Surrey, pp. 32, 2*s*. net).

Sir Charles Howell Thomas opened the proceedings of the Conference on September 17. In the course of his speech of welcome, he referred to the change in administrative control of the Institute, and praised the work of Lord Buxton in fostering the efficient work of the Institutes of Mycology and Entomology before they were taken over by the Executive Council of the Imperial Agricultural Bureaux. The future finance of the Institute of Mycology gives cause for concern, and was the subject of deliberation by a special sub-committee. It was recommended that representations be made to the various Governments supporting the Institute for restored or increased financial aid.

The Director (Dr. E. J. Butler), in reviewing the work of the Institute, showed that enormous financial losses are sustained as a result of fungal attack, and stressed the importance of disease surveys in demonstrating such loss. He also discussed the publication of the Institute's periodical *Review of Applied Mycology*.

The deliberations of the Conference naturally covered a wide field. Administrative measures against plant diseases, methods of standardisation of insecticides and fungicides, virus diseases, control methods for small cultivators, foot-rots of cereals, breeding and selection for immunity against disease, and several papers on diseases of particular crops, formed the main topics.

One important activity of the Conference lay in the drafting of a health certificate to be given to consignments of plants made within the Empire. This is not designed to replace any legislation or quarantine regulations, and carries nothing but a hall-mark of freedom from disease. If this practice is adopted extensively, it should mark a very considerable advance in the control of fungus diseases.

Radiation from a Transmitting Aerial

THE transmitting aerial of a broadcasting station designed for local or national service should confine as much as possible of its radiated energy to the horizontal direction, emitting as little as possible in directions making an angle of less than 60° with the vertical. The station will then have a large service area in which little fading is experienced. The demand for information on the design of such an aerial has given rise in recent years to some theoretical and experimental investigations on the general properties of antennæ used in radio transmitting stations.

A new and useful contribution to the state of knowledge on this subject has recently been given by Prof. P. O. Pedersen in a booklet published (in English) in Copenhagen ("Radiation from a Vertical Antenna over Flat Perfectly Conducting Earth." Pp. 49+35 figures. G. E. C. Gad: Vimmelskaftet 32, Copenhagen. Kr. 6.00). This work comprises a theoretical investigation of the radiation characteristics of a vertical antenna over flat perfectly conducting earth, having for its objective a determination of the most suitable dimensions of the antenna at the new Copenhagen broadcasting station. The theoretical results have been checked by measurements of the distribution of the current in the antenna and of the field intensity at various distances from the station. To facilitate the theoretical analysis, the current distribution in the transmitting antenna is in the first case assumed to be sinusoidal, although it was known that this is not valid in the practical case. The complete general formulæ for the radiated field for an antenna are obtained, and a most useful series of tables and graphs are provided, from which the radiation resistance and the distribution of the radiated field in the vertical plane may be calculated for antennæ of various dimensions.

The author then applies the results to the practical case of the vertical antenna at the Copenhagen station. Measurements of the current and voltage distributions in this antenna have been made to ascertain to what extent they differ from the sinusoidal case. The chief point of difference is that the node of current at the base of the antenna, which is just over half a wavelength high, is replaced by a current minimum only. The formulæ are therefore recalculated to take account of this new distribution, and it is shown that the alteration produced in the radiation distribution diagram for the Copenhagen antenna is almost negligible.

The practical and very satisfactory result of the work described in this paper is, therefore, that for the type of half wave transmitting aerial which is now employed at many broadcasting stations, the radiation characteristics may be calculated with good approximation by the comparatively simple analysis based upon a sinusoidal distribution of current in the antenna.

Work of the Bureau of Standards, Washington

ALTHOUGH owing to the necessity for economy the work of the U.S. Bureau of Standards had to be appreciably curtailed last year, yet the record of the work done as given in the annual report of the Secretary of Commerce (pp. 51–76) is impressive and interesting.

Valuable results were obtained in an experimental research on the transmission utility of the various frequencies used in broadcasting. The effects of ground waves and sky waves were determined. The sky waves were found to play a far more important role in distant daytime reception than was formerly supposed. The results obtained by measurements throughout the year on the height and ionisation of the conducting layers in the upper atmosphere which are responsible for long-distance radio transmission have greatly increased our knowledge of the subject. The relative effects produced by ultra-violet light, electrons and heavy ions have been determined.

Tests show that a new method of assembling watches having monometallic balance wheels and elinvar hairsprings has increased the uniformity of their time-keeping and has practically eliminated the deleterious effects that can be produced by magnetism. In association with the American Dental Association, the Bureau has developed and standardised methods for tarnish tests for dental alloys of low precious metal content. In connexion with criminal work, assistance was given in cases involving extortion, kidnapping, forgeries, threatening letters, etc.

The temperature of 'freezing' rhodium *in vacuo* has been found to be 1,966° C. with a possible inaccuracy of ± 3° C. The candle-power of tungsten filament lamp standards can now be found from the basic carbon filament standards. The vapour pressures of solid and liquid heavy hydrogen (deuterium) have been measured and from these data its freezing and boiling points and latent heats have been deduced. Interference measurements in the first spectra of several gases have been repeated and extended. Most of the spectral lines have been found reproducible to one part in fifty million and consequently are recommended as standards for spectroscopic and meteorological measurements.

Many useful hints are given amongst the results obtained. For example, tests made under carefully controlled conditions, with lighted cigarettes on grass and forest floor materials, show that the fire risk is greatly decreased when a cigarette paper tip ¾–1 in. long is applied in the course of manufacture over the end that is discarded. The possibility of utilising this result in practice is worth considering. The carpet wear-testing machine developed at the Bureau has been put to good use during the year. It has been found that the durability of a carpet is materially increased by increasing the density or the height of the pile and by the use of underlays.

Colour Inheritance in Silkworms

IMPORTANT results and conclusions regarding the inheritance of cocoon colour in silkworms have recently been published*. In these insects the colour of the silk secreted generally corresponds with that of the hæmolymph. Breeds with white cocoons have colourless blood, while those with yellow cocoons have yellow blood. In different strains the yellow varies from golden to straw-colour or reddish yellow, and some silkworms with yellow blood may weave a white cocoon, but it is not possible for a silkworm having white blood to produce a yellow cocoon.

It is concluded that migration of pigment takes place from the blood to the silk secretion. In some strains there is a change of colour in the different layers of the cocoon. For example, in the Chinese the outer layer is yellow-gold, becoming gradually paler to pure white in the innermost layer. The cocoon of the Italian strain, however, is colourless outside, becoming deeper coloured towards the interior. The colour is derived from the carotinoid pigments of the mulberry leaf, but its tint and distribution appear to depend on the conditions in which the pigment passes from the blood to the silk.

Two races with white (W) cocoons may, when crossed, produce a strain having yellow (Y) cocoons if one is white because the blood is unpigmented and the other because of incapacity of the silk gland to extract pigment from the blood. The possibility of migration of blood pigment to the silk is inherited as a dominant Mendelian character, but races differ in the time at which the silk glands show this capacity for taking up pigment. Thus in the Italian strain 'Fossombrone' the cocoon is nearly white in its outer layers, becoming golden yellow within, while in the Chinese yellow the outer layers of the cocoon are yellow. In crosses between them, this difference in 'precocity' of the action of the silk gland gives an intermediate result in the hybrid. Such results account for various discrepancies and the 'maternal inheritance' obtained by earlier investigators.

The colourless blood and white cocoons of the Japanese 'Awojiku' and other recessive whites is believed to be due to absence of capacity for absorbing the carotinoid pigments from the food through the intestinal wall; while in such dominant white strains as 'Baghdad' the colourless blood may be due to the presence of oxidising enzymes. In a green strain the pigment is a flavone derived from the leaf, which is present also in certain other strains. Thus not only are intestinal permeability and glandular permeability independent, but permeability to the flavones and the carotinoids are separate characters. White 'Awojiku' × 'Green' gives an F_1 with white blood and a 15 : 1 ratio in F_2. The explanation of this dihybrid result is not yet clear.

It is found that the pigments can be quantitatively extracted from the cocoons of various types. By these methods it is possible not only to reach a physiological definition of the hereditary factors in terms of cell permeability, but also to investigate the chemico-physiological individuality of the substances the metabolism of which is controlled by these genetic factors.

R. R. G.

* Studi di Genetica sui Bachi da Seta. Per Carlo Jucci. I: Il Colore del Bozzolo. *Reale Accad. d'Italia*, Mem. Classe Fis., Matemat. e Naturali. Vol. 5, pp. 347–477; 1934.

Educational Topics and Events

CAMBRIDGE.—The Frank Smart studentship in botany will be vacant on October 1, 1935. Any graduate of the University is eligible for the studentship provided that not more than fourteen complete terms have elapsed after his first term of residence. The value of the studentship is £200 per annum. A candidate must send his name, with a statement of the course of research he proposes to undertake, to Prof. A. C. Seward at the Botany School on or before October 2.

FROM the Kaiser-Wilhelm-Gesellschaft zur Forderung der Wissenschaften we have received two polyglot pamphlets describing the scope of the Society's work, which embraces the maintenance of thirty-four research institutes in Berlin, Heidelberg, Dortmund, Munich, Gottingen, Düsseldorf, Breslau, Dresden, the Ruhr and other places in Germany, Austria, Italy, Switzerland and Brazil. An appeal is made for the moral and material support of Germans the world over (in the English version, erroneously, "the widest circles in Germany"). One of the pamphlets relates to "Harnack House" in Berlin, a hostel for foreign visitors engaged in research in subjects germane to those studied in the Society's institutes. Here they have opportunities of intercourse with German savants, for the hostel serves also as a club for members of the Society and the staffs of the Institutes, about 150 of whom take their meals there every day. The House has a library, reading-room with numerous German and foreign periodicals, gymnasium, tennis-courts, bathrooms, lounge, terraces, etc. It is used by various learned societies for lectures and social functions, and is described as having become the centre of intellectual life in Berlin.

UNIVERSITY student housing conditions, past and present, form the subject of two interesting articles by Dr. W. H. Cowley, of Ohio State University, in *School and Society* of December 1 and 8. Nearly all the founders of the American colonial colleges were Oxford and Cambridge graduates or English-educated Americans; but the English college system of bringing together dons and students both for formal individual conferences and for informal social and intellectual intercourse failed to reproduce itself in the United States. College residential conditions were affected not only by the undeveloped state of the country, but also particularly by the bogey of student discipline, responsibility for which rested on the faculty member living in the dormitory, and this led to acute faculty-student antipathies. In the course of the nineteenth century, German university ideals became dominant in America and, as these recognised no obligation on the part of the university to concern itself with the life of the student outside the classroom, dormitories came to suffer from neglect where not dispensed with. Towards the end of the century a reaction began, and though considerably hampered by the recent general economic depression, is still active and promises to become even more important. The Oxford and Cambridge college system has now been adopted more or less at Harvard and Yale, the German point of view still prevails at California and Nebraska, and an American compromise, giving students body shelter and varying degrees of social education, is general.

Science News a Century Ago

Alexander von Humboldt in Paris

IN its column of "Miscellanea", the *Athenaeum* of September 12, 1835, said: "The celebrated Alexander von Humboldt is once more in Paris, and at the meeting of the French Academy of Sciences, on the 17th of August, called the attention of the members to the prints of footsteps, belonging to a quadruped, in the variegated sandstone, or *bunte sandstein* of Hildburghausen. It is an animal of the Plantigrada division, which traversed the rock while soft, and in various directions. A stone containing these impressions, from ten to twelve feet long, and three to four wide, has been sent to the collection of mineralogy at Berlin, of which the Baron submitted a beautiful drawing. There are four or five species of smaller impressions, which cross those of the larger quadruped at right angles, and are remarkable for the unequal dimensions of the fore and hind feet, and all have five toes. The rock is covered with them as with a network, and here and there sinuous serpular concretions, perhaps of plants on which the animal walked, perhaps some accidental effect of drying. The great importance of this discovery lies in the place occupied by this sandstone in the chronological series of rocks."

Earthquake in Lancashire

ON August 20, 1835, according to the *Annual Register*, "A shock of an earthquake was felt in different parts of Lancashire. . . . It was felt at Downham, Wiswell, Pendleton, Milton, Waddington and all the surrounding villages. At about twenty minutes to four o'clock the inhabitants were disturbed by a violent tremulous motion, and the sensation of heaving or rising and falling of the bed in which they lay, which was followed by a distinct noise resembling distant artillery. It was felt in Liverpool and was violent at Lancaster, where it threw down a chimney in Bridge-street, but without doing serious mischief. . . . The shock was felt very forcibly in Preston at about twenty-seven minutes before four o'clock. The noise produced by the internal thunder was likened to the sound of some heavy piece of artillery being dragged very rapidly over a pavement; and the whole duration of the shock to the latest vibratory motion produced by it was not less than thirty seconds."

Death of Leopoldo Nobili

ON August 23, 1835, the Italian physicist Leopoldo Nobili died. Born in 1784, Nobili was in his youth an artillery officer, but he afterwards became professor of physics in the archducal museum at Florence, the old habitat of the Accademia del Cimento. His principal researches were made in magnetism, electricity and light, on which subjects he left a large number of theoretical works. In some of his latter work he was associated with his distinguished countryman Melloni. Nobile made two valuable contributions to science, the first being his suggestion in 1830 of the astatic combination of the needles by which the sensibility of the galvanometer (Schweigger's invention) is greatly increased, and the second his invention in 1834 of the thermomultiplier or thermo-electric pile, which in the hands of Melloni and J. D. Forbes led to the discovery of many important facts. At a time when animal electricity was attracting much attention, Nobile demonstrated the passage of a current of electricity from the feet to the spine of a frog, and he was the discoverer of the beautiful coloured transparent films of metal deposited by electro-chemical processes.

Unveiling of Statue of Cuvier

ON August 23, 1835, a statue of Cuvier, who died on May 13, 1832, was unveiled at his birthplace, Montbéliard in the department of Doubs. The statue was by the sculptor Pierre Jean David (1789–1856), and was executed at Belleville, where it had been on view to the public. Deputations from many societies were present and orations were delivered in honour of the occasion. The house in which Cuvier was born was tastefully decorated and on it was placed the inscription—"Ici naquit G. Cuvier, le 23 Août 1769".

Death of John Macculloch, F.R.S.

ON August 21, 1835, Dr. John Macculloch, geogolist to the Trigonometrical Survey, died at Penzance through injuries sustained in a carriage accident. Born in Guernsey on October 6, 1773, he attended schools in Penzance and Plymouth; he entered the University of Edinburgh and in 1793 graduated M.D. At first an assistant surgeon in the artillery, he became chemist to the Board of Ordnance, practiced in Blackheath, and in 1814 was appointed lecturer in chemistry and mineralogy to the Royal Military Academy, Woolwich, and geologist to the Trigonometrical Survey. He made several excursions in Scotland, published a "Description of the Western Islands" and prepared a geological map of the country. He was elected a fellow of the Geological Society in 1808, and served as president in 1816–17. In 1820 he was admitted a fellow of the Royal Society: "As an original observer," said Lyell, "he yields to no other observer of our own time and is perhaps unrivalled in the wide range of subjects in which he has displayed great talent and profound knowledge." His portrait by Faulkner is preserved by the Royal Society.

Societies and Academies

CRACOW

Polish Academy of Science and Letters, June 3. A. RAJCHMAN: A complement to the Riesz-Fischer theorem. L. KOZLOWSKI: The movement of fluids accompanying changes of state. S. DOBINSKI: The density of liquid phosphorus. The density of phosphorus has been determined over the range 7°–68° C. The coefficient of expansion is 0·000531. A. JAGIELSKI and I. WESOLOWSKI: Contributions to the knowledge of the dielectric polarisation of solutions. Determinations of the electric moments of the dipoles of ether, *o*-nitroaniline, *o*-nitrotoluene, *o*- and *p*-nitrochlorbenzene. M. KAMIENSKI: Perturbations in the heliocentric movement of comet Wolf I during the period 1918–25. S. PIOTROWSKI: Several variable stars with eclipses. WLAD. GORCZYNSKI: The mean duration of insolation along the Mediterranean coasts. M. BLUMENTHAL: The mechanisms of the reactions between solid phases and one gaseous phase. B. KAMIENSKI: The influence

of the magnitude, symmetry, ion concentration and dipoles on the electrical potential at the surface of separation of phases: solution and dielectric. B. KAMIENSKI and W. GOSLAWSKI: A simplified dynamical method for measuring the dielectric potentials at the surface of separation of phases: solution and air. B. KAMIENSKI and W. GOSLAWSKI: The influence of the hydrogen ions on the dielectric potential of stereoisomers: quinine and quinidine. F. GAJOWCZYK and J. SUSZKO: Diastereoisomeric compounds: the naphthalene-1, 5-*bis*-sulphinylacetic acids. J. REYMAN and J. SUSZKO: Study on the hydroiodoquinines and on niquine. J. TOKARSKI: Petrographical studies of the Podolian loess. Petrographical analysis of a Grzybowice profile near Lwow. J. TUR: Embryonic neoplasmoids obtained experimentally. L. D. LIOSNER and MME. A. WORONZOWA: Continuation of the researches on the mechanism of the perforation of the opercular membrane in the metamorphosis of the batrachians (2). R. TOWARNICKI: The blood vessels in the brain of *Myxine glutinosa*. J. JAROCKI: Studies on the cilia of the fresh-water molluscs.

GENEVA

Society of Physics and Natural History, June 6. C. E. G. STUECKELBERG: The signification of multiple times in the theory of quanta. L. SCHAMES: The field between an α-particle and an atomic nucleus. Transforming a formula previously deduced for the potential between an α-particle and an atomic nucleus, it can be shown that this potential depends only on the ratio of the mass m to the atomic number, Z. For the same ratio, the potential curve divided by Z is the same. L. SCHAMES: The principal difference between the material mass and the magnetic mass. The magnetic masses can be cancelled by transforming into radii whilst for material masses no plausible reason is known at present for such cancellation. Consequently it is only 0·001–0·0005 of the entire mass which can be emitted in stars. This radiation finished, the star is composed only of neutral and material mass of very great density. J. WEIGLE: Molecular fields in the liquid state. The presence of a quasi-crystalline orientation of the molecules of a liquid gives rise to a field of force which opposes the rotation of the molecules. The variation of the mean electric moment of nitrobenzene in different non-polar solvents is attributed to the presence of this field, the magnitude of which can be calculated starting from experimental data. Up to concentrations of 50 per cent, this field depends on the solvent and on the nitrobenzene. But above 50 per cent the molecules of nitrobenzene alone determine it. H. SAINI: The thermal expansion of calcite. Measurements of the expansion of calcite, made between 25° C. and 100° C. by means of X-rays on a specimen coming from Mt. Big Timber, have given the same results, within the limits of the experimental errors, as those obtained macroscopically by J. B. Austin. Earlier measurements made by the X-rays on another specimen had given smaller coefficients. FERNAND CHODAT and M. RAAD: The variation of the buffer coefficient of culture fluids in the course of transmissible lysis. A. MERCIER: The expression of the second principle of relativist thermodynamics by means of Clifford numbers. W. H. SCHOPFER: Researches on the role of vitamin B on the nitrogenous metabolism of the Phycomyces. Quantitative researches show that the action of pure crystallised vitamin B is closely related to that of asparagin. Asparagin and vitamin B may be limiting factors with respect to each other. In the case of Phycomyces, it appears that it is especially the nitrogen metabolism which is controlled by vitamin B.

SYDNEY

Royal Society of New South Wales, June 5. EDGAR H. BOOTH: A regional magnetic survey. District: Mittagong–Bowral, New South Wales. This paper presents the corrected observations, over a region of twelve square miles, of a detailed vertical variometer survey. The area is particularly rich in igneous intrusions and flows, and provides a wide variety of both positive and negative anomalies for such detailed study, each isolated phenomenon dropping into place in the regional survey. The work was originally commenced to check whether the micro-syenite intrusion, "The Gib", which rises some 800 ft. between Bowral and Mittagong, was a plug; and developed into a regional survey, when it was found to be an asymmetrical laccolith. Particular attention is given to the examination and discussion of negative anomalies. The instrument employed was a Schmidt type vertical variometer. More than a thousand stations were employed, readings being correct to within 4γ over areas of slight variation (syenite at depth) where greatest accuracy was required. L. H. BRIGGS, D. A. PEAK and J. L. D. WOOLLOXALL: Constitution of matairesinol. The constitution of matairesinol, $C_{20}H_{22}O_6$, melting-point 119°, from *Podocarpus spicatus* has been determined, and it is now shown to be $\alpha\beta$-di-vanillyl-γ-butyrolactone.

VIENNA

Academy of Sciences, June 6. STEFAN MEYER: Calculation of the velocities of α-particles from their ranges, and its relation to the number of ion-pairs produced. FRIEDRICH KOCH and FRITZ RIEDER: Nuclear γ-radiation of beryllium. Investigation of the γ-radiation from α-irradiated beryllium by means of a Wilson chamber in a magnetic field shows that, in the formation of electron-twins, equal distribution of the available energy occurs. The numerical distribution of positrons and photo-electrons for different energies indicates the existence of several γ-lines. WALTER KOSMATH and OTTO GERKE: The radioactive climate and conditions of Badgestein, its bio-climatic and balneological significance. KASIMIR GRAFF: (1) Observations on the brightness, and (2) measurements of the colour, of Nova (1934) Herculis from December 1934 to April 1935. (3) Visual visibility of the Pleiades nebula and of nebula *NGC* 2237. (4) The diffuse nebulæ in the region of Orion. ERICH HAYEK: Formation of mixed crystals with tin monoxide. Mixed crystals of tin monoxide with oxides of other divalent metals—even with those stable as hydroxides under the experimental conditions—are obtained by precipitation from the appropriate salt solutions. The crystals show characteristic colours and their individuality is confirmed by their X-ray diagrams. MAX TOPERCZER: Daily variation of atmospheric dullness at Innsbruck. LEOPOLD VIETORIS: Groups of polydimensional paths. LEOPOLD KOBER: Geological investigations in the Apennines, especially of Calabria. KARL FEDERHOFER: Influence of the axial extension, inertia of rotation and thrust on the frequency of the bending of a circular ring. HUGO RÖSSNER:

Birds collected during the Austrian expedition to Asia Minor in 1934. R. EBNER: Gryllides and tettigoniides from the Anglo-Egyptian Sudan. About twenty species are enumerated and two new species, *Gryllus chopardi* n.sp. and *G. depressiceps* n.sp., are described.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, August 18

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".*

Official Publications Received

Great Britain and Ireland

The Federation of British Industries. Survey of Britain's Recent Commercial Policy. Pp. 49. (London: Federation of British Industries.) 1*s*.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No 34: The Influence of Physical and Mechanical Treatment on the Firmness of Butter. By J Lyons Pp. 541–558. (Dublin: Hodges, Figgis and Co; London: Williams and Norgate, Ltd.) 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), Nos. 22–26: Investigations on the Control of Seedling Diseases of Sugar Beet, by William Hughes; On the Characteristics of *Bacterium violaceum* (Schroter) and some Allied Species of Violet Bacteria, by George Cruess-Callaghan and M. J. Gorman; A Simple Titrametric Method for the Approximate Determination of Milk Phosphates, by G. T. Pyne; Report of the Irish Radium Committee for the Year 1934; Note on the Effect of Storage on the Colour and on the Free Fatty Acid Content of a Commercial Sample of Veterinary Cod-liver Oil, by E. J. Sheehy. Pp. 205–245. (Dublin: Hodges, Figgis and Co.; London Williams and Norgate, Ltd.) 3*s*.

Handbook to the Norman Lockyer Observatory. Compiled by Dr. William J S. Lockyer. Second edition. Pp. 54 (Sidmouth Norman Lockyer Observatory.) 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1633 (T. 3563): Reduction of Draughtiness of Open Cockpits. By B. Lockspeiser and A. Graham. Pp. 12+9 plates. 1*s*. 6*d*. net. No. 1637 (T. 3188): Aircraft Vibration. By H. Constant. Pp. 30+23 plates. 2*s* 6*d*. net. No. 1642 (T. 3573): Whirling Arm Experiments on Lateral Stability. By Dr. A. S. Halliday and C. H. Burge. Pp. 21+32 plates. 1*s*. 6*d*. net. No. 1644 (T. 3587): Effect of Mass Distribution on Spinning Equilibrium By S. B. Gates and R. H. Francis. Pp. 11+26 plates. 1*s* net. (London: H.M. Stationery Office.)

City of Leicester Museum and Art Gallery. Thirty-first Report to the City Council, 1st April 1934 to 31st March 1935. Pp. 28. (Leicester: Leicester Museum and Art Gallery.)

Royal College of Physicians of Edinburgh Annual Report by the Curator of the Laboratory for the Year 1934. Pp. 25. (Edinburgh: Royal College of Physicians of Edinburgh.)

Proceedings of the Royal Society of Edinburgh, Session 1934–1935. Vol. 55, Part 1, No. 7: The Mathematical Representation of the Energy Levels of the Secondary Spectrum of Hydrogen, II. By Dr. Ian Sandeman. Pp. 72–84. 1*s* Vol. 55, Part 1, No. 8. Some Series and Integrals involving Associated Legendre Functions, regarded as Functions of their Degrees By Prof. T. M. MacRobert. Pp. 85–90. 6*d*. Vol. 55, Part 1, No. 9: The Lunar Atmospheric Pressure Inequalities at Glasgow. By R. A. Robb and T. R. Tannahill. Pp. 91–96. 6*d*. (Edinburgh. Robert Grant and Son, London: Williams and Norgate, Ltd.)

Ministry of Health. Second Report of the Committee on the Standardization and Simplification of the Requirements of Local Authorities. Pp. 36. (London H.M. Stationery Office.) 6*d*. net.

Air Raid Precautions Handbook No. 2: Anti-Gas Precautions and First Aid for Air Raid Casualties. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 110. (London: H.M. Stationery Office.) 6*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 15: An Introduction to the Ecology of Intertidal Rock Surfaces on the Coast of Argyll. By Dr. J. A. Kitching. Pp. 351–374+1 plate. 3*s*. 6*d*. Vol. 58, Part 2, No. 16: The Tertiary Geology of Raasay, Inner Hebrides. By Charles F. Davidson. Pp. 375–407+3 plates. 5*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Other Countries

Publications of the South African Institute for Medical Research. No. 35. Entomological Studies—Studies on Insects of Medical Importance in South Africa, (Part 2). By Dr. Botha De Meillon Pp. 319–366. No. 36: Silicosis and Tuberculosis—Observations on the Origin and Character of Silicotic Lesions as shown in Cases occurring on the Witwatersrand. By F. W. Simson and Dr. A. Sutherland Strachan. Pp. 367–406+14 plates. (Johannesberg: South African Institute for Medical Research.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 19. (New York. New York Zoological Society.)

Smithsonian Miscellaneous Collections Vol. 94, No. 4: A Folsom Complex, Preliminary Report on Investigations at the Lindenmeier Site in Northern Colorado. By Frank H. H. Roberts, Jr. (Publication 3833.) Pp. iii+35+16 plates. Vol. 94, No. 5: Wave Lengths of Radiation in the Visible Spectrum inhibiting the Germination of Light-sensitive Lettuce Seed. By Lewis H. Flint and E. D. McAlister. (Publication 3834.) Pp. 11. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Office of Education. Pamphlet No. 60: Doctors' Theses in Education; a List of 797 Theses deposited with the Office of Education and available for Loan. Prepared by Ruth A. Gray. Pp. 69. (Washington, D.C.: Government Printing Office.) 10 cents.

Ibero-Americana. 8: Uto-Aztecan Languages of Mexico. By A. L. Kroeber. Pp. iv+27. 1*s*. 6*d* net. 9: An Historical Legend of the Zapotecs. By Paul Radin. Pp. v+29. 1*s*. 6*d*. net. 10. Aboriginal Population of Northwestern Mexico By Carl Sauer. 1*s*. 6*d*. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

University of California Publications in American Archæology and Ethnology. Vol. 34, No. 2: Tubatulabal Grammar. By Charles F. Voegelin. Pp. vii+55–100. 5*s*. 6*d*. net. Vol. 34, No. 3: Tubatulabal Texts. By Charles F. Voegelin. Pp. vi+191–246. 2*s*. 6*d*. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

Geological Survey of Nigeria. Bulletin No. 14: Fossil Fishes of Sokoto Province. By Dr. Errol Ivor White. Pp. 78+10 plates. (Lagos: Government Printer.) 12*s*. 6*d*. net.

U.S. Department of the Interior: Geological Survey. Bulletin 847–A: The Contact Mining District, Nevada. By F. C. Schrader. (Contributions to Economic Geology, 1934–35.) Pp. iv+41+4 plates. 15 cents. Professional Paper 181: Upper Eocene Foraminifera of the Southeastern United States. By Joseph A. Cushman. Pp. ii+88+23 plates. 25 cents. Water-Supply Paper 745: Surface Water Supply of the United States, 1933. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. vii+220. 15 cents. Water-Supply Paper 748: Surface Water Supply of the United States, 1933. Part 8: Western Gulf of Mexico Basins. Pp. vi+180. 15 cents. Water-Supply Paper 754: Surface Water Supply of the United States, 1933. Part 12: North Pacific Slope Basins C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+170 15 cents. Water-Supply Paper 755: Surface Water Supply of Hawaii, July 1, 1932, to June 30, 1933. Pp. v+125. 10 cents. (Washington, D.C.: Government Printing Office.)

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 10: An Investigation of the Uplift Pressure on a Model of Bay IV, Khanki Weir and the Prototype. By A. N. Khosla, E. McKenzie Taylor and H. L. Uppal. Pp. 8+7 plates. 10 annas; 1*s*. Research Publication, Vol. 1, No. 5. A Statistical Examination of the Uplift Pressure Data obtained from Model Experiments. By Jai Krishnan Malhotra and Harbans Lal Uppal. Pp. 31. 10 annas; 1*s*. Research Publication, Vol. 5, No. 3: Study of the Evaporation of Water from a Soil Surface with reference to the Fluctuations of Water-Table. By Dr. V. I. Vaidhianathan and Hans Raj Luthra. Pp. 8+6 plates. 8 annas; 9*d*. (Lahore: Punjab Irrigation Research Institute.)

Trinidad and Tobago Administration Report of the Conservator of Forests for the Year 1934. Pp. 20. (Trinidad: Government Printing Office.) 16 cents.

Forest Bulletin No. 90: Official List of Trade Names of Indian Timbers. Pp. iv+12. (Delhi: Manager of Publications.) 4 annas; 5*d*.

Memoirs of the Geological Survey of India. Vol. 66, Part 1: The Natural Gas Resources of Burma. By C. T. Barber. Pp. x+172+xviii+14 plates. (Calcutta: Geological Survey of India.) 6.8 rupees; 10*s*. 6*d*.

Royal Observatory, Hong Kong. Meteorological Results, 1934. Prepared under the direction of C W. Jeffries. Pp. iv+139. (Hong Kong. Government Printers.) 3 dollars.

Report of the Kodaikanal Observatory for the Year 1934. Pp. 4. (Delhi: Manager of Publications.) 2 annas; 3*d*.

Deutsche Seewarte. Das Sechzigste Jahr der Deutschen Seewarte, 1934. Pp. iv+55. (Hamburg: Deutsche Seewarte.) 0.50 gold mark.

The Imperial College of Tropical Agriculture. Five Years of Cacao Research, 1930–35. Pp. 10. (Trinidad. Government Printing Office.) 1*s*.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 94, Partie 2. Rapport administratif (1934–1935). Pp. 84. (Copenhague: Andr. Fred. Høst et fils.) 3 50 kr.

Science Reports of the Tokyo Bunrika Daigaku. Section A, No. 41: Calculation of X-Ray Terms according to Heisenberg's Theory on Electron-Holes. By Gentaro Araki. Pp. 189–216. 40 sen. Section A, No. 42: On the Type of Riemann Surfaces. By Zen-ichi Kobayashi. Pp. 217–233. 30 sen. Section B, No. 32: New or Rare Species of Brachyura, collected by the *Misago* during the Zoological Survey around the Izu-Peninsula. By Tune Sakai. Pp. 63–88+plates 6–8. 60 sen. Section B, No. 33: Über drei in der Susswasser-Muschel (*Anodonta lauta* v Martens) lebende Ciliaten (*Conchophthirus*). Von Mitsuo Uyemura. Pp. 89–100+plate 9. 25 sen. (Tokyo: Maruzen Co., Ltd.)

Smithsonian Miscellaneous Collections Vol. 93, No. 10: An Introduction to Nebraska Archaeology. By William Duncan Strong. (Publication 3303.) Pp. vii+323+25 plates. (Washington, D.C.: Smithsonian Institution.)

Catalogues

Catalogue of Books on Natural History, including Anthropology, Zoology, Evolution, Botany, Entomology, Ornithology, Forestry, Microscopy. Pp. 28. (London: W. and G. Foyle, Ltd.)

Chance's Resistance Laboratory Glass. Pp. 16. Standard Nessler Glasses. (Pamphlet No. 284.) Pp. 4. Latest British Analytical Balances. (Leaflet No. 285.) Pp. 4. Terry's Anglepoise Lamp. Pp. 8. (London: A. Gallenkamp and Co., Ltd.)

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Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3434 SATURDAY, AUGUST 24, 1935 Vol. 136

Mechanism of Society

THE limitations which are being placed on scientific work in certain countries have forced many scientific workers, otherwise indisposed to concern themselves with political affairs, to realise that science and politics cannot be kept entirely apart. The direction of scientific investigation is in fact determined by social conditions to a much greater extent than is commonly realised by the scientific worker, and it is probably true that technological development rather grows out of than determines social needs. While science has undoubtedly been unjustly blamed for many of the evils which have resulted from the application of scientific discoveries, the danger of a reaction against science is sufficiently real to make it imperative for the scientific worker to pay much more attention to the social and political consequences of his work.

The limitations to which we refer, however, go far beyond this, and constitute a threat to the quality of scientific work as well as to its quantity or direction. They raise fundamental issues which cannot be evaded, and they could scarcely be more lucidly and forcefully put than in Lord Davies's book entitled "Force", which has recently been made available in a cheaper form*. This is essentially a scientific study of the right or moral use of force in every sphere of human society, and especially in international relationships.

While few in the world of science do not now realise the impracticability, if not the impossibility, of drawing a distinction between pure and applied science, there are still many who fail to realise that science on the scale it is pursued to-day is an integral part of the social organisation of the State. Wherever he works, the man of science is a part of the machinery of State, and there is no real immunity of science from its political environment. If the scientific worker desires liberal endowment for his work and reasonable freedom in its direction, he must at least make an effort to secure the understanding and support of those responsible for the government of the State in which he serves.

In some countries to-day, that sympathy and support can only be secured at the price of the acceptance of particular political dogmas and views which are in the lineage of those credulities and superstitions from which in the past science has liberated the human soul. It is not merely the quantity and direction of scientific work that are involved. Reason is again being pitted against passion and prejudice, and the shackles which we once thought science had finally shattered are in danger of being riveted again, perhaps even more firmly, on the minds of men.

Under such conditions, the quality of scientific work cannot long remain untainted, and this reason alone should quicken the interest of the scientific worker in Lord Davies's theme. Moreover, when many, both within the ranks of science and without, are coming to consider the ways and means by which the work of government can be more and more based on a scientific study of the available facts, and less and less upon mere prejudice or guess-work, we are witnessing in one country after another the sweeping away of individual rights, systems of justice and hard-won political liberties.

In such circumstances, it is imperative to

* Force. By Lord Davies Re-issue. Pp. x+242. (London: Constable and Co., Ltd., 1935.) 3s. 6d. net.

discover the fundamental causes of these failures whether in the national or international sphere. Lord Davies finds it simply in the failure to recognise and act upon the fundamental principle that the exercise of force should be limited to the police function. Force is either the servant of justice or the tool of policy, and in a series of lucid and forceful chapters he shows how failure to recognise this principle is the root cause of the loss of liberty and the growth of political oppression and tyranny in Europe to-day, as well as of the failure of the League of Nations to develop into an international authority with the power to ensure justice and peace.

Examples are quoted from recent history in a masterly manner in support of this thesis, including some trenchant criticism of the Irish policy of successive British Governments, but always Lord Davies is honestly endeavouring to face the facts in post-War Europe and to supply a moral basis for dealing with the most urgent problems of to-day. Inevitably he comes once more to his well-known view that force can only be rightly employed in the international sphere when it has been scientifically organised as the sanction of international law in the form of an international police force.

The issues with which we are faced in this way are urgent. Without dwelling unduly on the horrors of modern warfare, Lord Davies reminds us of our fatal habit of thinking of the next war in terms of the last and failing to face the facts of a scientific age. We cannot take all the powers and advantages with which science has now endowed us without in certain directions accepting restrictions upon our freedom of action, whether in such a matter as the use of the highways or in this matter of the use of force. The measures now being taken by the Air Raid Precautions Department of the Home Office will delude no reasonable person into thinking that any effective defence against air attack is possible, short of the abolition of war.

Lord Davies maintains that the only defence against a potential aggressor is to implant in his mind the certainty of an overwhelming reprisal by a superior force, under the control of an international executive and backed by the moral support of an impartial authority such as the League of Nations. The weakness of the collective system without such an international police force ready for instant action against an aggressor is apparent, and no thinking man can be blind to the narrowness of the verge between the downfall of the collective system and international anarchy and disaster. This is a matter which concerns the scientific worker and every other citizen of good will. The vast increase in the potentialities of force during the last twenty-five years through the application of scientific discovery and invention indeed lay special responsibility on the man of science to assist in working out a solution.

If the primary task is one of education, scientific workers have definite responsibilities in that work. They must lend all their energy to the creation of a new mentality as favourable to the constructive use of force in national and international affairs as the old outlook on war has been hitherto in destruction. The peaceful evolution of institutions, whether on a national or an international scale, depends for its realisation upon the ability of men to agree upon the purposes they must have in view. The whole process of politics depends upon the assumption that reasoned discussion will secure effective agreement about whatever elements of justice are to be found in any proposed arrangement, such as an international police force; and in securing such agreement scientific workers must play a part neither more nor less than that of other sections of the community.

In the present structure of society, the participation of the technician and scientific worker, as of the administrator and professional worker, is indispensable, if that inherent tendency of institutions, which have once rendered invaluable service but are now archaic and declining, to delay the evolution of new and more appropriate institutions, is to be overcome by constitutional means. Adaptation is the secret of existence; and it is only as we accept the challenge thrown down by these issues and seek to develop by clear and courageous thinking and bold experiment that society can avoid self-destruction, and turn its new powers into instruments of security. Creative and adventurous thinking as well as a scientific approach are demanded, and scientific workers must recognise their responsibilities and utilise to the full those opportunities of creative work which lie before them in this field. In this way the dark menace which now overshadows the world may be dispelled, the limitations on human thought removed and science regain its full freedom of creative endeavour, while new fields of effort will be opened up in which the scientific method and spirit may win yet greater triumphs for the human race in its mastery of its environment.

The Beginnings of Applied Chemistry

Origins and Development of Applied Chemistry By Prof. J. R. Partington. Pp. xii + 597. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 45*s*. net.

THE evolution of an idea or event usually makes a very interesting story, and probably none more so than the origins of some of the industrial applications of chemistry. Indeed, several of the modern chemical arts have been practised for thousands of years in forms which become more and more primitive and obscure as they are traced backwards, until at last their humble origins are lost in the haze of prehistoric antiquity.

Many charming stories have been written about one or other of those chemical industries the origin of which antedates all books and writings; although, in some cases, industries have passed through many strange vicissitudes in their development, and have been ultimately abandoned, for, as Lucretius has said:

> The rolling years bring on a change of things;
> What once was valued loses all worth,
> And what was worthless rises in its stead.

In the work under notice, Prof. Partington has presented a wonderful and valuable account of the sources, production and uses of materials in Egypt, Babylonia, Assyria, the Ægean, Asia Minor, Persia, Syria and Palestine, from the earliest times to the end of the Bronze Age—"wonderful" because of the painstaking care in handling so large a mass of evidence involving, we are informed in the preface, 7,000 references; and "valuable" because it supplements so effectively and pleasantly our general knowledge on the historical side of industrial chemistry.

Each territory is treated as one unit, so that the origin, occurrence, manufacture and use of a given material, say, iron, are described country by country. Some might consider that it would have been better to have collated the data with reference to each material, as E. O. von Lippmann did towards the end of his "Entstehung und Ausbreitung der Alchemie" (Berlin, 1919–31). I think that Prof. Partington has adopted the better plan; the alternative would probably have been preferable had the narratives extended through the Middle Ages.

The materials treated in Prof. Partington's book include the metals and alloys: copper, silver, gold, zinc, brass, mercury, tin, bronze, lead, arsenic, antimony, iron and steel, cobalt, nickel, and platinum; and various chemical compounds—common salt, natron, sal ammoniac, nitre, alum and vinegar—as well as sulphur; the gem-stones—natural and artificial; building materials—plaster, stucco and bricks; pigments and paints; ink for writing; oils—expressed and distilled; pomades and ointments; incense and perfumes; products derived from plants; medicinal preparations; and fermented drinks and other beverages. There is a temptation to select one or two items in the list to illustrate in detail how thoroughly the work has been done, and to compare that work with evidence collated in other ways.

Operations connected with the arts of metallurgy, dyeing, weaving textiles, tanning leather, brewing, baking, embalming, pottery, glass-making and the imitation of gem-stones, are also described. Here we can see the beginnings of many an industry practised in modern times; and that not always to the credit of the later workers, judging by what they have accomplished with their heritage—*St. Matthew* xxv, 25.

The data confirm M. Berthelot's belief that chemistry is founded on knowledge slowly accumulated by practical discoveries in metallurgy, medicine and other arts; and the opinion of J. B. A. Dumas when he said:

> Let us confess at once, without going round the subject, that practical chemistry took its rise in the workshops of the smith, the potter, the glass-blower, and in the shops of the perfumer.

Of course, the mere mechanical practice of operations, essentially chemical in their nature, does not make the early artisans into chemists in anything but name. Otherwise, the first man to light a fire, stew a rabbit, or roast a pig might have been styled the father of chemistry. In the words of A. F. de Fourcroy (1782):

> It is vain and ridiculous to attempt to trace the origin of chemistry to the first men who worked in the metals, cut and polished stones, fluxed sand, or dissolved and crystallized the salts. This would be analogous to an attempt to trace the elements of geometry in the efforts of the savage to trim irregular fragments of rock to a more regular form in order to adapt them to his first needs.

The index is worthy of the book; it is singularly complete, occupying as it does 65 pages, three columns per page. It is difficult to see how those interested in the subject can carry on economically without the assistance of the "Origins and Development of Applied Chemistry".

J. W. MELLOR.

Gymnosperms

Gymnosperms: Structure and Evolution
By Dr. Charles Joseph Chamberlain. Pp. xi+484. (Chicago: University of Chicago Press; London: Cambridge University Press, 1935.) 21*s*. net.

EVEN in these days of specialisation, no real botanist dismisses the Gymnosperms from his field of study. They still possess an inherent interest, although for a hundred years they have been classic ground. The first impulse came from Robert Brown, who first realised the morphological significance of the Gymnosperms. From that beginning the knowledge of them has been built up by generations of botanists, from Hofmeister, to D. H. Scott in our own day. The attraction of the group depends on the strategical position which they occupy in relation to Angiosperms and Pteridophytes, respectively. This morphological and evolutionary ascendency really derives from the fact that Gymnosperms abut on a rich hinterland of fossil petrifactions so well preserved that their investigation has given, and should continue to give, convincing results. All this is fully appreciated by Prof. Chamberlain, and forms indeed the *raison d'être* of the present book.

American botanists have taken an important share in the advancement of Gymnosperm knowledge, owing to (1) the large numbers of living conifers which grow in the forests of the North American continent, the life-histories of which have been worked out, especially by the school of Coulter and Chamberlain at Chicago; (2) the richness of the country in Bennettitales as elucidated by Wieland; and (3) the intimate studies of living Cycads by Prof. Chamberlain himself, who in his world-wide travels has seen, studied and collected, in its own habitat, every genus and a large number of species of existing Cycads. This contact with his material in the field is an admirable and outstanding feature of his book. In this connexion, frequent reference is made to the question whether Gymnosperms are ever effectively pollinated by insects. The matter is one of importance as on its determination must rest any decision as to whether evolution at the Gymnosperm stage has been influenced by insects, as it undoubtedly has been in the more modern Angiosperms. Prof. Chamberlain is sceptical as to existing evidence: "In spite of occasional claims, it is very doubtful whether there is a single case of insect pollination in any Gymnosperm".

All the same, it is an attractive and important field for properly directed and methodical investigation, because much depends upon it. In some Palæozoic seeds, for example, *Physostoma*, as many as four hundred pollen grains have been counted in the pollen chamber, and it is difficult, unless a very prolonged exposure of the micropyle be presumed, to account for such bountiful supplies on the hypothesis of wind carriage alone.

The book has a definite style of its own which may be best compared to the 'running commentary' of the broadcaster. Otherwise stated, a previous knowledge of the subject matter is required for benefit to be derived. To say this is not to condemn the book (which indeed is brightly written) though it does cast some doubt on its utility for the purposes of undergraduate students (cf., dust cover). The comparative morphology, anatomy and embryology of the various living groups of Gymnosperms are well displayed, though too many dogmatic statements have crept into the text. The illustrations are excellent and many previously unpublished. If anything, they are too generously provided, and a few of the redundancies might be usefully replaced by distribution charts.

It is natural that the book should (apart from the non-Cycadian fossils) be based largely on American researches, as these have been a great feature in the output of the Department of Botany at Chicago, as developed by the late Prof. J. M. Coulter and his colleague, Prof. Chamberlain. For the fossil data (other than Bennettitales) the results of European work have been incorporated, and indeed form the evolutionary foundation of the book. Lack of practice in palæobotanical technique is responsible for a few fantastic statements, but they are not real blemishes. Though America has not yet made available the relevant petrifactions that would have made this book 100 per cent American, the author gets his revenge by taking his readers for a personally conducted tour through the beautifully arranged and reconstructed carboniferous forests of the Field Museum at Chicago! Nothing approaching these exists in Europe.

Prof. Chamberlain reproaches his "English friends" for their persistent use of the name Pteridosperms for seed-bearing plants having the habit of ferns—and employs the term Cycado-filices. Reference to the original source (No. 431 in the Bibliography), where this group was established, would disclose the grounds for so doing, together with the reason why "Cycado-filices"

seemed inadequate. This latter name had been proposed by Potonie to cover the whole series of vegetative remains showing structural relations with both Ferns and Cycads. The term Pteridosperm is reserved for the elect among these—to be included if and when they are proved to have possessed seeds. The unassigned residue (which may remain in the convenient 'waste-paper basket' of Cycado-filices) should include both unverified Pteridosperms and perhaps other plants which never attained to the status of seed-bearing.

F. W. O.

X-Rays in Pure and Applied Science

(1) Handbuch der Physik
Herausgegeben von H. Geiger und Karl Scheel. Zweite Auflage. Band 23, Teil 2: Röntgenstrahlung; Ausschliesslich Röntgenoptik. Redigiert von H. Geiger. Pp. ix+541. (Berlin: Julius Springer, 1933.) 56.70 gold marks.

(2) Industrial Radiography
By Dr. Ancel St. John and Herbert R. Isenburger. Pp. ix+232. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21*s.* 6*d.* net.

(3) Les rayons X: au laboratoire, à l'hôpital, à l'usine
Par Marc Privault. (Actualités scientifiques et industrielles.) Pp. 204. (Paris: J.-B. Baillière et fils, 1934.) 25 francs.

THESE three books, very different in type and in object, serve to illustrate the intensely specialised nature of modern physics, and also the high degree of specialisation within its fairly clearly defined sub-branches.

(1) The second edition of vol. 23 of the well-known "Handbuch der Physik", edited by Geiger and Scheel, treats of several branches of radiology from the academic point of view. The confines of one volume have proved inadequate for the revision of a subject growing so rapidly, and vol. 23 now appears in two parts. In part 2, Profs. Bothe and Kirchner deal with the absorption and scattering of X-rays, Dr. Kulenkampff writes on the continuous X-ray spectrum, Prof. Ewald discusses the study of the solid state by means of X-rays, and Dr. Steinke contributes a section dealing with cosmic rays.

The contributions of Bothe and Kirchner and of Kulenkampff are considerably longer than those of the first edition, and bring the topics up to date. The section by Ewald, which is new, opens with a clear and detailed account of crystal classification and space-grouping, deals adequately with X-ray interference, temperature and atomic effects, and the design and use of X-ray spectrometers. A very valuable chapter deals with the interpretation of powder photographs and the usual projections used in this work. The rapid advance of the study of cosmic radiation is shown by the fact that, although the subject has only been seriously investigated for some seven years, the physical nature and properties of the radiation are now fairly well known. Much, however, remains to be done before we have a clear understanding of the origin of the cosmic rays. That they originate in space appears to be beyond doubt, but whether their occurrence is due to atomic disintegrations in young stars or spiral nebulæ, whether they arise through some interaction of interstellar matter with electrified particles (or perhaps neutrons), or whether their genesis is due to some physical phenomenon at present outside our knowledge is one of the problems which is yet to be solved. The experimental side of the work is set down in considerable detail by Dr. Steinke, together with a brief but adequate summary of the somewhat speculative theories of the origin of cosmic rays.

One cannot praise this volume more highly than by stating that it maintains to the full the high standard set by the other and well-known volumes of the "Handbuch der Physik".

(2) "Industrial Radiography" by St. John and Isenburger is a treatise for the technician, and within the limits of its title is self-contained and complete. The first seventy pages contain an account of the general properties of X-rays and the construction of X-ray apparatus which will probably be found adequate for a proper understanding of the later parts of the book. The importance of a proper photographic technique and accurate dark room manipulation of films is rightly stressed. One frequently finds operators taking great pains in adjusting objects to be radiographed, making exposures with carefully controlled voltages and exposure times, and then developing and fixing in stale solutions at unsuitable temperatures, apparently unaware that such processing conditions give radiographs in many respects similar to those which would result from using quite different kilovoltages and exposure times. The importance of using dark rooms of

ample size and provided with good ventilation is also emphasised.

Industrial radiography is largely concerned with making radiographs of metal objects, often with thick walls and of irregular shape, and the correct setting up of such objects frequently presents difficulties. The authors have apparently had a very wide experience of this work, and have included in the book a large number of practical points which are likely to be of great service to those whose experience is more limited. Similarly, the radiography of small objects has its own peculiar problems, which again are dealt with adequately.

A chapter is devoted to radiography with radium gamma rays (the authors call the resulting pictures 'gammagraphs' to distinguish them from X-ray pictures which they call 'exographs'), a method of attack which seems likely to increase in use, particularly since the influence of scattering on the radiographs is much less with gamma rays than with X-rays, and therefore much thicker objects may be successfully examined.

The book is characterised by a large number of illustrations carefully chosen to show how common defects in metals appear on radiographs. In very many cases the radiograph appears by the side of a photograph showing the defect, and not infrequently photomicrographs are also given.

An appendix contains a valuable set of exposure charts showing the exposures required at various voltages for various thicknesses of aluminium, steel and copper, a chart from which the exposure required for gamma ray radiography of steel objects may be found and also a very complete bibliography.

The authors are to be congratulated on producing a practical treatise which should be invaluable to novices and a useful reference work for all industrial radiologists.

(3) "Les rayons X" by Privault is an introductory textbook, touching on all the principal aspects of X-rays from the points of view of both pure and applied science. With so comprehensive a field, it must follow that the treatment of each branch of the subject is somewhat meagre. One feels that it is impossible to give even a reasonably adequate summary of the present state of all the branches of radiology (using the word in its widest sense) within the limits of two hundred small pages.

The Profession of Librarian

Rôle et formation du bibliothécaire: étude comparative sur la formation professionnelle du bibliothécaire. (Dossiers de la Coopération intellectuelle.) Pp. 385. (Paris: Institut international de la Coopération intellectuelle, 1935.) 50 francs.

THIS volume is based on a questionnaire sent out by the International Institute of Intellectual Co-operation, and it provides the most detailed account of the status of librarians in various countries which has yet been published. Thirty-five countries or States are included in the survey, of which twenty-seven are in Europe, the others being South Africa, Brazil, Canada, China, the United States, India, Japan and New Zealand. The information asked for by the questionnaire related to the categories of librarians and libraries existing in the country concerned, the authorities to which they were subject, the qualifications required of candidates for the library profession, whether and what diplomas or other examinations were available and the particular courses of study provided in connexion with them, and their location and control.

The work should prove of the greatest value to all interested in the library profession and the improvement of librarianship as a whole. It is very desirable that the volume should have a wide circulation so that the people of all countries may realise that the average librarian is required to know a great deal more than how to hand books out to a reader. It is gratifying to note the progress that has been made in recent years, and especially since the War, in many countries to ensure that librarians shall be men and women of high educational standing and that their emoluments shall be reasonably adequate. In the Netherlands, for example, every public library official is expected to hold a special diploma, and any Government subvention is withheld from a library the personnel of which is wholly or in part without a diploma.

The chapter on England is written by Mr. J. D. Cowley, director of the School of Librarianship of the University of London, and is an admirable summary of the organisation of libraries and the facilities for the training of librarians now available. It is interesting to note that candidates for a librarianship in Brazil have to produce, among other things, a certificate of good manners, as well as one of good health. Even in China, since 1927,

intending librarians have to pursue a course of study in a school of librarianship in China or elsewhere, possess a diploma of a university or college and also practical experience of more than one year, while junior assistants must possess a certificate of secondary education.

Possibly the most extensive course is that in Russia, where no fewer than twenty-four colleges of library economy have been founded. Admission to a college is granted to persons who have terminated a secondary school course of seven years, and the plan of study in the library college extends over three years, a total of 4,426 hours being allocated to the different subjects, which include physics, chemistry, mathematics and graphic processes, in addition to the strictly professional topics. Of special interest is the fact that, of the 1,440 hours of study allocated to the third year's studies, 82 have to be devoted to Leninism.

The introductory chapter summarises the results of the inquiry, and recommends the development of international collaboration by the foundation of an international series of courses or conferences, attached to a university or an institution controlled by some national authority, for the purposes of further research in library economy, as an experimental measure, the necessary finance being assured by Governmental subventions from all interested parties. A bibliography of twenty-six pages, geographically arranged, is not the least valuable section of this work, which should be found on the shelves of every library anxious for the betterment of itself, its staff and its service to the community. B. M. HEADICAR.

Technical Aspects of Emulsions:
being the Papers read at a Symposium held in London, December 7th, 1934, under the auspices of the British Section of the International Society of Leather Trades' Chemists. Pp. vi+150. (London: A. Harvey, 1935.) 6*s*. net.

THE twelve sections of this book concern the physical chemist, the physician, the patent agent, the engineer, and the technologist in many industries (laundry-work, agriculture, food-preparation, woollen-textiles, varnish, leather, rubber, bitumen).

Diversity was the aim of the symposium and the book is witness to the attainment of that aim. This prompts the thought that, in books of this kind, there may be a place for the thread of unity which runs through diversity. The reviewer turned to the first section, that on the mechanism of emulsification, hoping there to find that thread traced through the other papers. He found, instead, a stimulating account of the effect of ultra-sonic waves in making and breaking emulsions: a piquant *hors d'œuvre*.

Diversity without unity has its drawbacks. Words are used loosely. On p. 93 the word 'nucleus' means the oily part of mayonnaise emulsified with some of the aqueous part thereof. The physicist uses the word in another sense, the biologist in yet another. Perhaps there is not much harm done; but there may be some. Dialects tend to be both used and confused. From confusion to obscurity is but a step. The passage at the bottom of p. 4 is rather near obscurity: "A device of this kind might be characterised by the fact that the droplets formed travel parallel to another with different velocity along a too great a distance and that this may cause an orthokinetic coagulation".

Nevertheless the sections of the book are well written. That is the reason why a faulty passage strikes the eye. Some sections are good descriptive catalogues with references by the hundred; others have a philosophic turn; yet others are both bibliographical and philosophical; all are illuminating; one is of outstanding interest, namely, that on the use of highly dispersed emulsions in the treatment of toxæmic conditions. The compilation is the record of an important symposium meant to be diverse in treatment. F. S. A.

Mathematik im Dienste der nationalpolitischen Erziehung mit Anwendungsbeispielen aus Volkswissenschaft, Geländekunde und Naturwissenschaft: ein Handbuch für Lehrer. Herausgegeben im Auftrage des "Reichsverbandes Deutscher mathematischer Gesellschaften und Vereine" von Adolf Dorner. Pp. iv+118. (Frankfurt am Main: Moritz Diesterweg, 1935.)

THIS book is intended to provide teachers of mathematics with examples connected with the aims of the National Socialist Government. The book is not a persistent exposition of the logic of any part of pure or of applied mathematics. It is a collection of detached chapters, explaining in words various matters which both interest the Nazis and are capable of simple quantitative treatment. Formulæ which are important are stated; but mostly without proof. Numerous examples are given, with algebraic or arithmetical answers.

The remarkable aspect of the book is the selection of subject matter. Broadly, one may say that there are 59 pages of social statistics and 49 pages of military geometry. In the statistical part one finds explanations of means, standard deviations and correlations; also treatments of life-insurance, of savings banks, of Mendelism, of unemployment, of the birth-rate, of trade and food supply. At the end of the book there are 15 pages of German statistics. An interesting diagram (on p. 23) shows the great contrast between the age-distribution of Germans in 1931 with that in 1910.

The part of the book here described as military geometry deals with map-reading, with aerial navigation, with protection against bombs dropped from above, with the paths of projectiles *in vacuo* and in air, also with sound-ranging. Except for these, the ordinary applications of mathematics to mechanics and to physics are notably absent. The words *Stimme* and *Wahl* (= vote, election) do not appear in the index. L. F. R.

A New Angle on Health

(Nature's Provision for the Health and Happiness of Mankind). By Surg.-Capt. D. H. C. Given. Pp. xvii+160+5 plates. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 7*s*. 6*d*. net.

THE author of this book was for more than eight years stationed at Singapore, and this he claims has given him a unique opportunity to contrast the health of a primitive Asiatic community of diverse races with that of naval personnel and white civilians. He finds that the physical standard of the Asiatic labourer is *A* 1, as compared with the *C* 3 standard of civilisation, that his teeth are on a par with his physical standard, and that he does not suffer from the diseases common among Western races.

It is to be noted that in the Asiatic labourer of Singapore, the author is dealing with a very selected and restricted group, which cannot be compared with our own population as a whole. Similarly, when it is stated that in contrast to the European, the epidemic influenza in the Asiatic in 1931 was mild and free from complications, it should be recalled that India and South Africa suffered some years ago from a devastating epidemic of influenza, and this disease in native races is not necessarily a mild one; in fact, one epidemic may differ entirely in severity and in incidence from another one.

Basing his arguments on what in many instances we believe are faulty premises, the author attributes the ills from which we suffer to the effects of urbanisation, overcrowding, extremes of poverty and riches, the decline of agriculture, and under- and improper feeding—much of which is doubtless true—and condemns our Western civilisation as being founded on selfish greed, industrialism and parasitism. He concludes that so long as selfishness continues to dominate the lives of men, so long will the human race fail to realise the happiness for which it strives, and that the precepts of Christianity form the only basis of a healthy and happy life. R. T. HEWLETT.

Technics and Civilization

By Lewis Mumford. Pp. xi+495+16 plates. (London George Routledge and Sons, Ltd., 1934.) 18*s*. net.

THIS book provides an interesting and thought-provoking contribution to the history of the machine and its sociological effects on humanity. Mr. Mumford divides the machine age into three great periods: (1) the 'eotechnic' based on animal, water and wind power; (2) the 'paleotechnic' which came in with Watt's steam engine and had its basis in coal and iron, and (3) the 'neotechnic' which is now dawning and promises industrial decentralisation, cleanness, leisure and abundance, its basis being the long-distance transmission of electric power.

Discussing the assimilation of the machine, Mr. Mumford points out that as machinery was developed, attention came to be centred more and more on the product, people valuing the machine for what it produced. The machine thus appeared purely as an external instrument for the conquest of the environment to the neglect of the actual forms of the products, the actual collaboration and intelligence manifested in creating them and the educational possibilities of this impersonal co-operation itself. The objects rather than the spirit that produced them were assimilated, and so far from respecting that spirit, the aim was to make the objects themselves seem to be something other than the product of the machine. The industrialists and engineers themselves did not believe in the qualitative and cultural aspects of the machine. The possibility that technics had become a creative force which was rapidly ordering a new kind of environment and producing a third estate midway between Nature and the humane arts, was far from the minds of those who actively promoted the mechanisation of production.

The Recollections of a Geographer

By E. A. Reeves. Pp. 224+8 plates. (London: Seeley, Service and Co., Ltd., n.d.) 8*s*. 6*d*. net.

AFTER fifty-five years service in the Royal Geographical Society as map curator and instructor in surveying, Mr. Reeves retired in 1933. Many hundred travellers and explorers have owed to him all they knew of survey work, so that his influence has reached to every corner of the globe. Here are glimpses of men like Stanley, Bates, Burton, Nansen and many others who brought their observations and discoveries to the Society.

Mr. Reeves has anecdotes about many and a kindly word for all. He has allowed no adverse criticism to appear in his pages; but he has clearly omitted many of his experiences, for the book is not long as a record of half a century of noteworthy people. A hurried sketch of the progress of exploration and survey in that period is included as well as some account of Mr. Reeves's own work on magnetism and in the improvement of surveying instruments. Finally, there is an unconvincing chapter on the author's psychic experiences.

It is a kindly and ingenuous book that to many will recall a teacher of great ability and untiring patience, and to others will appeal as a sketch of fifty years of discovery as seen from the Royal Geographical Society, by the one man above all others who has directed exploration.

Diesel Engine Design

By Harold F. Shepherd. Pp. vii+277. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17*s*. 6*d*. net.

THE Diesel engine has now been constructed successfully in so many different types that any book on its design which is not restricted to one particular line of development must almost necessarily become too discursive to be of practical value to the designer. It is in this respect that H. F. Shepherd's "Diesel Engine Design" fails to meet the real need for a book or series of books on this subject. The historical and descriptive treatment and the discussions on numerous points which arise in design are all to the good; but the author does not really grapple with the actual problem of design until the last chapter or two. It is an introduction to, rather than a manual on, design. J. A. C.

Wave Action on Vertical Wall Breakwaters

By Dr. Brysson Cunningham

THE efficacy of the resistance to wave action of vertical wall breakwaters built on a rubble mound foundation has been called into question recently by reason of two unfortunate, and, in fact, structurally disastrous, incidents which have been experienced, at Catania in Sicily in March 1933 and at Algiers in North Africa in February 1934. The matter is one of fundamental importance, since quite a number of important harbours in the Mediterranean and elsewhere are protected by breakwaters of this type. It was discussed at considerable length by an eminent Italian engineer, Prof. E. Coen Cagli, in a lecture which he delivered lately at the Institution of Civil Engineers, a short reference to which was made in NATURE of July 20, p. 99.

The vertical wall breakwater is, in principle, a homogeneous or at any rate, so far as may be practicable under the conditions of the site, a coherent structure, generally formed of prismatic concrete blocks properly coursed and bonded, in contrast to the mound breakwater which consists essentially of a mass of rubble stone of various shapes and sizes deposited more or less at random on the sea floor and sometimes surmounted by heavier artificial units. The two types are, therefore, strikingly different in character, though it is rare to find a pure example of either, since the rubble mound is frequently capped with a coping course and parapet of blockwork, whereas the wall, when the site is in water of considerable depth, has generally to be founded on a bed of rubble, on account of subaqueous constructional difficulties and also from motives of economy. Moreover, at a certain depth below the surface, it is known that wave action ceases to produce any appreciable disturbance in a rubble mound foundation.

By way of illustration, it may be said that the harbours of Dover, Tynemouth and Peterhead in Great Britain are of the vertical wall type, while an excellent example of the mound type is to be found in the outer breakwater, or "Grand Jetée", at Marseilles.

Until comparatively recently, despite its importance from a scientific as well as a practical point of view, experimental research into the phenomena of wave action had not been conducted on any systematic lines. It is true that individual observations have been recorded from time to time and valuable deductions made therefrom by several scientific writers, but from lack of official co-operation and financial assistance the data so obtained have been somewhat fragmentary and incomplete. It is satisfactory to note that at the port of Genoa a very efficient apparatus is now installed for the purpose of taking continuous records. Into the outer breakwater at a suitably exposed point has been built a special monolith, or hollow block (Fig. 1) containing apparatus whereby at a series of successive levels ranging from 10 metres below to 3 metres above sea-level, piezometric values of wave stroke are recorded both mechanically on the spot and also by electrical transmission to a wave oscillation register situated in the sheltered area of the inner harbour. By means of this apparatus a number of valuable pressure records and 'oscillograms' has been obtained and described by Dr.-Ing. Salvatore Levi[1]. An account of the installation has been published by Commendatore Ing. Albertazzi, the Chief Engineer of the port[2].

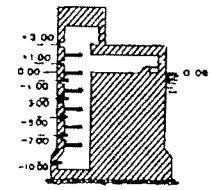

FIG. 1. Wave pressure recording monolith at Genoa.

It is not proposed in this article to discuss the numerical values of wave pressures recorded by this and other means, but to direct attention to the general principles and conditions of stability of vertical wall breakwaters in the light of the instances of failure which have occurred at Catania and Algiers. I had an opportunity, while in Sicily recently, of discussing the former breakwater with Signor A. D'Arrigo, who was associated with its construction, and last year, at Algiers, I similarly discussed the causes of the collapse of the second arm of the Mustapha Jetty with Monsieur P. Rénaud, the Engineer and Port Director there.

To commence with, it is to be noted that there was an essential difference in construction between the two breakwaters, cross-sections of both of which are given in Figs. 2 and 4. Both were founded on rubble mounds, the first (Catania) at a depth of 12·5 metres below sea-level, and the other (Algiers) at 15 metres below sea-level; but, whereas the Catania mole consisted of a series of disconnected piers, 12 metres in transverse section, made up of 320-ton concrete blocks, each 12 metres by 4 metres by 3·25 metres, unbedded and unconnected in any way by cement joints or reinforcement, the piers of the latter, 11 metres across in transverse section, were welded into a

monolithic whole by means of vertical wells, or shafts, filled with concrete reinforced by steel bars.

Now as to the circumstances of collapse. While in course of being lengthened, the Catania mole had already suffered damage from an east to south-east storm (without wind) on February 22, 1930, which engendered waves of 7 metres height and 200 metres length. Some horizontal displacement of the courses took place and a part of the work was dismantled. The damage, however, was made good without any change in the design, beyond raising the platform on the harbour side by a height of 1 metre, with the view of increasing the load on the piers. The first arm of the jetty had then been built out to its full length when another storm of more exceptional severity from the north-east, with waves 7·5 metres in height and 230 metres in length, broke on March 26, 1933, and completely demolished the work for a length of 700 metres, the parapet wall and successive layers of blocks above the two lowermost courses being swept into the harbour, in some cases a distance of as much as 40 metres, and more or less fractured and disintegrated. It is to be noted, as can be seen in Fig. 3, that the blocks in the process of displacement slid over one another, due to the lack of adhesion at the joints. Signor D'Arrigo states that there was also a vibratory motion observed, due to the uplifting action of the waves on the underside of the blocks, and that this was the primary cause of fracture.

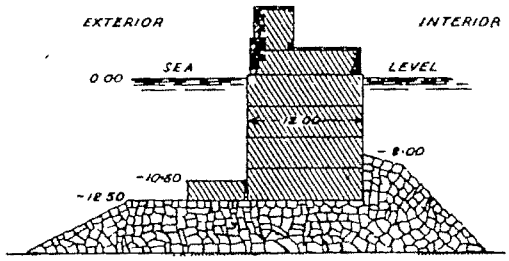

FIG. 2. Catania breakwater as constructed.

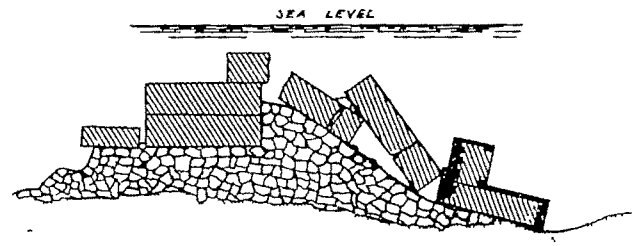

FIG. 3. Catania breakwater after demolition.

In the case of the Mustapha Jetty, on the other hand, the monolithic piers of which it was composed remained intact under wave impact until they were finally overturned. The north-easterly tempest of February 2–3, 1934, which caused the collapse of 401 lineal metres of the mole, was accompanied by waves of 9 metres height and 300 metres length[3]. The vehemence of the wave stroke, however, failed to overturn the wall by direct impact, to which effective resistance was offered for many hours. Failure, when it occurred, was due to the powerful suction of the recoiling waves, which drew down the rubble mound and scoured out a trench in the sea floor at the foot of the wall, into which the latter subsided, as shown in Fig. 5, and then disintegrated. There is every probability that had the rubble mound been able to resist the suction of the 'backdraught', the wall itself would have come through the ordeal with but slight, and certainly not irreparable, damage.

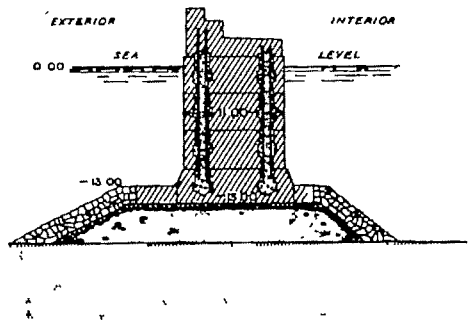

FIG. 4 Mustapha Jetty, Algiers, as constructed.

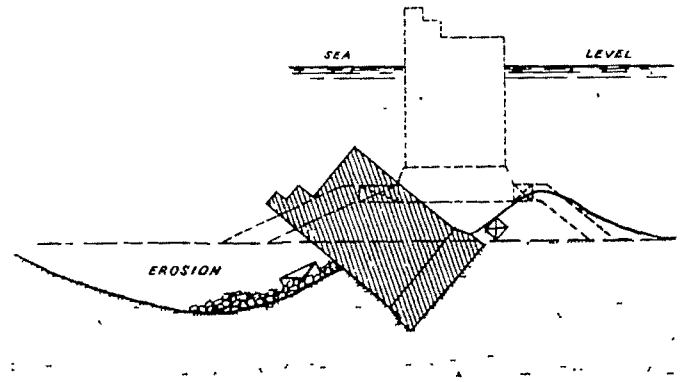

FIG. 5. Mustapha Jetty, Algiers, showing process of collapse.

The view expressed in his lecture by Prof. Coen Cagli, who, it should be stated, was mainly responsible for the introduction into Italy of the

vertical wall breakwater, is that neither of these untoward incidents justifies a condemnation of the type, which in every case other than Catania in Italian seas, has demonstrated a satisfactory stability. This view commends itself as perfectly reasonable and Prof. Cagli is fully justified in maintaining, that if, in the case of the Catania breakwater, the wall had been monolithic in structure instead of consisting of a vertical series of disconnected blocks, imperfectly bedded; and if, in the case of the Algiers breakwater, the rubble mound foundation had been made sufficiently resistive to suction and undermining, neither of the storms, despite their unprecedented severity, would have been likely to produce the serious results which actually occurred. It has been decided, however, that both breakwaters are to be reconstructed as rubble mounds without vertical wall superstructures. In the case of the Algiers mole, this was perhaps inevitable from a consideration of the nature of the sea floor and the accumulation of debris from the old work.

In consonance with a resolution passed at the fourteenth International Congress of Navigation at Cairo in 1927, a special committee of experts from various countries, including Sir Leopold Savile as representative of Great Britain, has been engaged in investigating the problem of wave action, and the installation at Genoa above referred to constitutes one of the avenues of research. Prof. Cagli has himself been conducting a series of experiments with small-scale models in co-operation with Prof. A. Stucky at the Hydrological Laboratory of the University of Lausanne. The results obtained from the tests carried out up to the present were given by Prof. Cagli in his lecture, and they may be briefly summarised as follows:

(1) The complete agreement of the actual pressures recorded at Genoa with those obtained by means of tests on the model of the Principe Umberto Mole at that port indicates, on one hand, that the method of research by tests on small-scale models, based on the law of mechanical similitude, is strictly applicable to the study of wave stroke, while, on the other hand, it demonstrates, contrary to the opinion expressed by some writers on the subject, that oscillating waves, in violent storms at any rate, are not converted by reflection at a vertical wall into actual 'standing waves' (Ital.: *onde stazionarie*; Fr.: *clapotis*), but maintain their essential trochoidal characteristics with a modified orbital movement and that they exert pressures which notably exceed those of actual standing waves of the same magnitude. For example, it was found that the total effort at Genoa of a normal wave of 5 metres height and 110 metres length exceeds by 26 per cent the total effort which would be exerted by a standing wave engendered by the same ordinary wave and having therefore the same length with twice the height.

(2) The tests on a small-scale model of the Mustapha Jetty at Algiers have demonstrated (Fig. 6) that under the terrific conditions of the storm of February 3, 1934, with waves 9 metres high and 185 metres long in the immediate vicinity of the work, the wall experienced a total pressure of 147 tons per lineal metre of structure, which is greater by 35 per cent than the pressure which would have been exerted by a standing wave of the same length and 18 metres high. As a consequence of this effort, the intensity of pressure on the rubble mound along the inner edge of the wall base should have amounted to 8·25 kgm. per sq. cm. (about 7½ tons per sq. ft.); certainly an excessive load, but one which, very likely, was not actually realised to the full calculated extent by reason of the intervention of certain impedimentary factors, such as the continuity of the mass concrete capping of the breakwater and the rise of the water inside the harbour as a result of the rise of level outside.

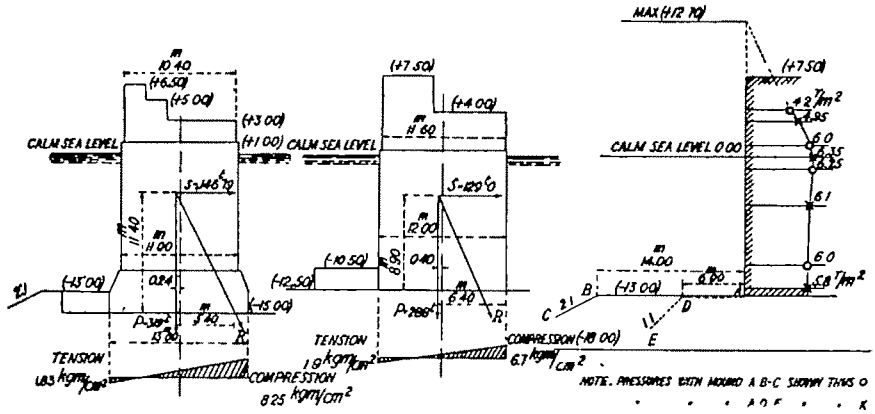

FIG. 6. Stability diagram, Mustapha Jetty, Algiers.

FIG. 7. Stability diagram, Catania breakwater.

FIG. 8. Pressures exerted by wave 6·50 metres high, 155 metres long.

(3) The model of the Catania mole having, in turn, been subjected to the impact of waves 7·50 metres high and 155 metres long adjacent to the structure, similar to those observed in the storm of March 26, 1933, the result of the tests (Fig. 7) showed that the wall experienced a total pressure of 129 tons per lineal metre of structure, producing an intensity of pressure on the rubble foundation of 6·70 kgm. per sq. cm. (say, 6 tons per sq. ft.); a pressure which the wall, 12 metres thick, would clearly have withstood better than

the Algiers mole if it had been monolithic in character.

(4) The results of the whole series of experiments on small-scale models have enabled it to be established that the intensity of pressure exerted against a vertical wall by oscillating waves diminishes progressively above smooth sea-level in the ratio of two thirds of the height above this level. Thus, with a surface level pressure of 6 tons per square metre, at a height of 3 metres the pressure would be reduced by 2 tons to 4 tons per square metre. The pressure diagram is, in fact, substantially a triangle with a base angle of about 60°.

(5) In none of the tests with small-scale models relating to wall breakwaters at Genoa, Algiers and Catania, standing in depths of 15, 21 and 18 metres respectively and having their wall bases located at levels of − 10, − 13 and − 10·50 metres respectively, could waves of the maximum observed heights of 7, 9 and 7·50 metres be caused to break, even superficially, in front of the wall, although given an increase in length in the open 'sea' beyond admissible proportion, that is, up to forty times their height. In every case, in fact, there was produced a maximum unitary effort, almost exactly uniform over the whole immersed section of the wall and equal, as in all the other experiments, to the hydrostatic pressure corresponding to the height of the waves. It is therefore justifiable to conclude that if the depth of the sea at the site of the work exceeds, as is usually the case, twice the height of the greatest storm waves to be expected in the locality, and if the base of the vertical wall lies at a depth of one and a half times the same height, there should be no danger of waves breaking completely against the work. Moreover, it has been possible to ascertain that under these conditions, the width of the benching at the foot of the wall and the inclination of the side slope do not affect in any way the intensity of stroke exerted by the waves against the wall (Fig. 8).

While under the foregoing conditions it is permissible to exclude the risk of complete breaking of the heaviest storm waves against the work, it is not impossible, however, that during storms accompanied by very strong wind, the waves, retarded in their propagation by the progressive decrease in sea depth and by the effect of the slope of the rubble foundation, may, under the influence of the wind, break superficially and so produce against a part of the face of the wall pressures which are more intense than would be those exerted by the same waves if they remained purely oscillating up to the moment of contact. Unfortunately, no observations or experiments so far made have provided data for the estimation of the intensity and distribution of these exceptional pressures, so that no precise indication can be given of the additional strength required to withstand such shocks. However, it is to be noted, on one hand, that waves accompanied by strong wind are sensibly shorter than waves of the same height propagated in the entire absence of wind, with the consequence that the total effort exerted against the wall is considerably less in the first than in the second case; and, on the other hand, that the effort exerted by the breaking wave, which is purely dynamic and exhausts itself in a comparatively short time, affects the resistance of the wall to shear much more than to overthrow or slip. It follows, adds Prof. Cagli, that if the work be designed with the requisite margin of safety for withstanding oscillating waves of the maximum height for the locality, unaccompanied by wind, the monolithic structure of the wall, or its component piers, may be deemed sufficient to ensure the requisite stability in the event of an augmented stroke from waves of maximum height which happen to break superficially in approaching the wall during storms accompanied by strong winds.

Such are the results obtained from the experimental study of wave action on small-scale models, and while Prof. Cagli admits that they may not be considered exhaustive, they afford useful guidance in dealing with wave action in relation to structures of the vertical wall type[4].

Speaking in general terms, as the outcome of a consideration of the disasters at Catania and Algiers, it would appear from the former that despite the difficulties arising from unequal settlement in a rubble foundation, a continuous monolithic wall is better adapted to withstand the known characteristics of wave stroke than a wall of detached superimposed blocks, even of cyclopean magnitude; and from the latter, that the action of the recoiling wave on the rubble mound and a soft sea bottom requires very careful consideration. Hitherto, it has been held with a certain amount of justification that the undulatory movement of the sea (which extends on a decreasing scale to considerable depths) is not likely to have much, if any, depreciatory effect on a rubble mound lying at a level of about 40 ft. below the surface of the sea. At Algiers the rubble mound was seriously disturbed and the sea floor eroded at depths considerably greater, even approaching double the figure in question. It seems essential, therefore, for complete security that the recognised standard should be reconsidered, and an appreciably increased depth adopted in situations where the 'fetch' is sufficient to promote the generation of waves of the order of 25–30 ft. in height and 500–600 ft. in length.

[1] *L'Ingegnere*, August 1, 1934.

[2] Bulletin No. 18 of the Comitate Nazionale Geodetico e Geofisico (July 1929); also *Annali dei Lavori Pubblici*, February 1932.

[3] Vide *Engineering*, January 11, 1935.

[4] See also: E. Coen Cagli, "Sulle condizioni di stabilità dei moli a parete verticale", *Annali dei Lavori Pubblici*, June 1934.

An Ancient Chinese Treatise on Alchemy

By Prof. J. R. Partington, M.B.E.

ONE of the early Chinese texts on alchemy is the *Ts'an T'ung Ch'i* of Wei Po Yang, who has been called the father of Chinese alchemy. His treatise has been regarded as the earliest work in the Chinese language which is devoted exclusively to the subject, although it is by no means the earliest Chinese writing which makes mention of alchemy. It shows, in fact, that a definite and extended tradition of alchemy was in existence when it was written, and it mentions several earlier alchemists who are otherwise known, either from their own writings or from notices in Chinese historical works. It seems reasonable to conclude that, for two or three centuries before Wei Po Yang, the Chinese had been engaged in an attempt to transmute base metals into gold, not because gold was intrinsically valuable but because of the supposed magic efficacy of artificial gold in prolonging life. This belief is found also in ancient Egypt[1] and is no doubt based on the unalterable character of the noble metal. The Chinese believed that an artificial gold could be prepared from cinnabar (mercuric sulphide) which would have a more powerful action than natural gold.

The early Chinese alchemical works attach considerable importance to the synthesis of cinnabar from mercury and sulphur and its resolution into its constituents[2]. These operations also attracted considerable attention among the early Egyptian alchemists, the oldest of whose works, extant in Greek, are supposed to go back to the early centuries of the Christian era[3], but may be based on texts a century or so earlier. Since Wei Po Yang lived in the second century A.D., and since alchemists are mentioned in Chinese records two or three centuries before this, it is evident that the origins of alchemy in China and in Hellenistic Egypt are practically contemporary. The oldest known works in both cases are of approximately the same date, and in both cases they mention earlier works and traditions—sometimes fabulously early.

It is, therefore, very difficult to decide with our present information whether the origins of alchemy in Egypt and China were independent or not, and, if they were, which was earlier in date. An Arabic origin of Chinese alchemy, on the other hand, although it has been suggested, seems very improbable, since a knowledge of alchemy did not reach the Arabs from Egypt until several centuries after we find alchemy well known in China. A common origin of Chinese and Arabic alchemy is quite possible.

Wei Po Yang was a Taoist philosopher, and the development of alchemy in China was almost certainly closely connected with the later developments of Taoism[4]. He was born in the province of Kiangsu, and in the year 121 A.D. was summoned to the Court, but declined the invitation, having no liking for officialdom. He describes himself in the epilogue of the *Ts'an T'ung Ch'i* as "a lowly man who has no love for worldly power, glory, fame or gains", but content to spend his life in peace in a retreat in an unfrequented valley —definitely Taoist sentiments. His work is one of the Taoist classics, and is still read in China. It purports to be a commentary on the old Chinese classic, the *Book of Change*, but is really a treatise on the preparation of the elixir, or pill of immortality. Chinese works say Wei Po Yang and three disciples went to the mountains to prepare this, and when it was made he tried it on a dog, which died instantly. Wei Po Yang then asked what should be done, whereupon the disciples suggested that he should try it himself. He did so, saying that it would be a disgrace to live if the preparation of the medicine had failed through lack of concoction, and he also died instantly. One disciple then said: "Our teacher is no common person. He took the medicine and died of it. He must have done that with some special intention." He also took the medicine and died. The other two disciples then left to arrange for the burials, but when they had gone Wei Po Yang revived, and resuscitated the disciple and the dog with some of the well-concocted medicine; they all went the way of the immortals, leaving a note with a wood-cutter for the other two disciples.

Wei Po Yang's treatise has been translated by Dr. Lu-Ch'iang Wu and annotated by Prof. Tenney L. Davis[5], the translation being preceded by an interesting general discussion. It states that the *Book of Change*, the Taoist doctrines and alchemy are merely three variations of the same thing under different names. It makes use of the early Chinese philosophical conceptions of the *Wu-hsing* (five elements: wood, earth, water, fire and metal) and *Yin-Yang* (two contrary principles). The words *yin* and *yang*, originally meaning dim or obscure, and bright, respectively, later took on the meanings of numerous pairs of opposites. Thus, *yang* meant the sun or male principle and *yin* the moon or female principle, the interaction of which produced the five elements, each identified with a planet. Dr. Wu and Prof. Davis point out that this doctrine of two contraries dominated

chemistry for a long period, and it may be suspected that it lingers in forms not mentioned by them even at the present day. Dr. Wu suggests, in opposition to generally received opinion, that the notion of *yin* and *yang* is not purely Chinese, that it came with the occult doctrines associated with it from some other civilisation, possibly from Babylonia or Egypt, and perhaps alchemy came with it at the same time. "But the search for the elixir of immortality seems to bear no necessary relation to the occult doctrine of the contraries, and we are unwilling to conclude that the two necessarily derive from the same origin." It is suggested that there is a clear and natural affinity between Chinese alchemy and Taoism: if alchemy did not originate out of Taoism, the latter at least "supplied a congenial medium for the growth of alchemical ideas". This theory has, in fact, seemed probable to a number of former investigators[2,4].

The translation of the *Ts'an T'ung Ch'i*, which Wu and Davis divide into sixty-nine chapters, shows that it is, as we should expect, an obscure and mystical work. It contains a number of subtle ideas and is enlivened by a sense of humour and an absence of egotism which contrast favourably with the writings of the Arabic and later European alchemists. Of positive chemical knowledge, such as we frequently find in the Greek alchemists[3], there is very little, if any. An insistence upon secrecy is found.

As a specimen of the theoretical speculations in the *Ts'an T'ung Ch'i*, the following may suffice:

Chapter 18. "One, knowing the white, should hold firm to the black. For then divine light will come in due course. The white is the essence of gold and the black is the basis of water. The water is the control of the *Tao* and is one in number. At the beginning *yin-yang* is black, and with yellow sprouts, the master of the five metals and the river chariot of the north. Hence lead is black on the outside but holds gold flower in its bosom."

Those who are familiar with the Greek chemical texts will find many points of contact between the ideas in them and those of the above and many other passages in the Chinese text. The formation of litharge from lead is probably indicated.

As a specimen of the description of practical operations, the following may be quoted:

Chapter 64. "Above, cooking and distillation take place in the cauldron; below blazes the roaring flame. Before goes the White Tiger leading the way; following comes the Grey Dragon. The fluttering Scarlet Bird flies the five colours. Encountering ensnaring nets, it is helplessly and immovably pressed down and cries with pathos like a child after its mother. Willy-nilly it is put into the cauldron of hot fluid to the detriment of its feathers. Before half the time has passed, Dragons appear with rapidity and in great number. The five dazzling colours change incessantly. Turbulently boils the fluid in the furnace. One after another they [the dragons ?] appear to form an array as irregular as a dog's teeth. Stalagmites, which are like midwinter icicles, are spit out horizontally and vertically. Rocky heights of no apparent regularity make their appearance, supporting one another. When *yin* and *yang* are properly matched, tranquility prevails."

We have here a fairly clear account, as alchemical literature goes, of some process of solution and crystallisation.

Chapter 66. "White at first and then yellow, it finally becomes red on the outside and on the inside. This is called the first furnace and it is as large as a grain of millet. All this is the work of nature and has nothing to do with untoward doings. It is like the fact that the *ch'i* (ethereal essence) of the mountains and the waters rises to give clouds which then become rain. Again, it is like the reduction of mud to give dust and the destruction of fire to give earth. The bark of the *nieh* tree dyes yellow and the *lan* (indigo) dyes blue; the boiling of hides yields glue, and the *ch'ü nieh* yeast ferments to give liquor. It is easy to get results when the starting materials and the desired products are of the same kind. Otherwise it is very difficult."

Many points of contact between these and other statements in the Chinese treatise and in the Alexandrian Greek treatises can be found, so that the general conclusion of Dr. Wu and Prof. Davis, who do not favour much relation, is scarcely borne out by detailed examination: they cite, in fact, several parallels with Zosimos in the notes and could have cited a good number more. These notes suggest parallels with later works on European alchemy, and there is an index of (transliterated) Chinese words.

Dr. Wu and Prof. Davis are to publish later some alchemical chapters from Ko Hung, a celebrated Chinese Taoist philosopher and alchemist of the fourth century, and the history of chemistry will be enriched by their work. The translation of these early texts is a difficult task, from which previous sinologists have turned away in something like despair, but there is nothing like making a start. Criticism and improvement can follow this, but they do not precede it.

[1] Partington, "Origins and Development of Applied Chemistry", London: Longmans, Green and Co., Ltd., 1935. 23, 181.

[2] O. S. Johnson, "A Study of Chinese Alchemy", Shanghai, 1928. Wieger, "Taoisme", Hien Hien, 1911-13. W. A. P. Martin, "The Lore of Cathay", New York, 1901.

[3] Berthelot, "Collection des Alchimistes Grecs", 3 vols., Paris, 1888. F. Sherwood Taylor, "A Survey of Greek Alchemy", *J. Hellenic Studies*, 50, 109–139; 1930.

[4] Edkins, *Trans. China Branch Roy. Asiat. Soc.*, Hong Kong, 1855, pt. 5, 83–89; a valuable paper; cf. Partington, NATURE, 120, 158, 1927. Johnson, ref. 2, curiously omits to mention it.

[5] Lu-Chi'ang Wu and T. L. Davis, *Isis*, 18, 210–289; 1932. Davis, *Scientific Monthly*, Sept. 1930.

Obituary

Mr. C. E. Stromeyer

HALF a century ago the practices used in the design and construction of industrial boilers left much to be desired in the way of scientific treatment, and it is no exaggeration to say that Charles Edmond Stromeyer, as chief engineer to the Manchester Steam Users' Association, was a leading spirit in the process of transforming the existing art into something approaching an exact science. The reason is not difficult to find, since he possessed an inborn capacity for investigation and research, to which was added the experience gained during seventeen years as an engineer surveyor to Lloyd's Register of Shipping. During that persistent endeavour, which occupied thirty years, the city of his adoption was a centre of interest for those engaged on the construction and maintenance of boilers, for engineers from distant lands frequently called upon him—and the pilgrimage continued after the year of retirement, in 1928. For this reason, a wide circle of friends must have welcomed the honorary degree of Dr. Ing. that was conferred last year by the Technische Hochschule at Aachen on its old graduate.

It is strange to recall that Stromeyer's apprenticeship was terminated due to an incapacity for further manual labour, since up to a few weeks before his death at Bad Nauheim, on July 23, in his eightieth year, he daily attacked the work that lay before him in the study and the laboratory. As a further indication of this unceasing activity of mind and body, it may be remarked that the manuscript of his "Unity in Nature", which may still be read with much pleasure and profit, was written *en route* during bi-weekly journeys between Manchester and London in the years preceding the War, when he was much occupied on professional and scientific affairs in London. Not the least important of those interests were matters connected with the foundation of the National Physical Laboratory.

Since he belonged to a generation that regarded education mainly as a training for independent thinking, Stromeyer's contributions to the proceedings of the Royal Society and our senior engineering and naval institutions almost invariably formed milestones by the way of progress in his sphere of interests. The ground included in that sphere was extensive, as he made the first direct determination of Poisson's ratio, used his interference strain indicator to measure the stresses on ships and the strains on railway bridges in the 'eighties, and contributed an instructive paper, on map-projection, to the International Geographical Congress held at Berlin in 1900. His work on the fatigue of metals is of outstanding merit, and the involved investigations doubtless gave rise to an original contribution presented in 1907 to the Manchester Literary and Philosophical Society, in which the atomic weights of the elements were expressed in the form of a harmonic series. In view of such a wide and deep knowledge of natural philosophy, it is in the nature of things that his "Marine Boiler Management and Construction" should have attained a sixth edition, apart from foreign translations of the volume.

With his intense devotion to work, anything short of transparent honesty met with Stromeyer's strongest disapproval, and he considered no weapon too heavy to handle in the defence of what appeared to be the right course of conduct. That characteristic must have served him well during the War period, in undertaking the exacting duty of examining and reporting on the safety of secondhand boilers that would not have been used in other circumstances.

To those who were privileged to know him intimately, Stromeyer's cultured and attractive outlook on life was a constant source of pleasure, as the labour of the day never seemed to tire the boyish spirit that was the deep-seated source of his activity. The welfare of his assistants was as real a concern to him as was their success in professional affairs, and they, along with many others, will place him in that small company of whom it may be said that they were "Servants upon horses, and princes walking as servants upon the earth". In that role his charming wife bore him faithful company. D. L-T.

Dr. Arthur Bramley

THE death of Dr. Arthur Bramley on July 19 deprives chemical and metallurgical science of a brilliant worker. Born in 1878, he was forced to leave school early, and served a full apprenticeship to the hosiery trade. He commenced his technical education in Halifax Technical College, and in 1904 obtained a staff appointment there. This was followed in 1906 by a national scholarship of the Royal College of Science where he graduated, carried out research work and finally became private research assistant to Prof. J. C. Philip. With the latter he conducted a number of researches on the physico-chemical properties of solutions and ionic complexes the results of which are published in the *Journal of the Chemical Society*. He then proceeded to investigate the physical properties of binary liquid mixtures, for which work he was awarded the degree of D.Sc.

The second phase of Dr. Bramley's service to science commenced with his appointment to the technical staff of British Dyestuffs Corporation at Huddersfield, where he remained until he was appointed to take charge of the Department of Pure and Applied Science, Loughborough College, in 1918. At Loughborough he commenced a long series of researches on the diffusion of non-metallic elements into iron and steel and was able to show that the mechanism of this diffusion follows the normal physico-chemical course. These researches, published over a period of fifteen years, obtained for

him the award of the Carnegie Gold Medal in 1929.

Apart from his research work, Dr. Bramley was an enthusiastic teacher and had been instrumental in building up an active Pure Science Department in Loughborough College; his untimely end cut short a career which had promise of even greater fruition.

WE regret to announce the following deaths:

Dr. R. W. Brock, dean of the Faculty of Applied Science in the University of British Columbia, known for his work in economic geology, on July 31, aged seventy-one years.

Prof. B. L. Robinson, emeritus professor of systematic botany in Harvard University, an authority on the classification of American spermatophytes, on July 27, aged seventy years.

Mr. W. T. H. Spicer, formerly first ophthalmic surgeon at St. Bartholomew's Hospital, known for his work in connexion with the teaching of ophthalmology, on August 8, aged seventy-four years.

Mr. A. H. Swinton, a well-known naturalist, author of "Insect Variety, its Propagation and Distribution", on July 25, aged ninety-one years.

News and Views

Archæology in the Cambridge Fens

IN another column of this issue of NATURE (see p 304) there appears a brief account of the results of tree pollen and vegetation analyses of peat deposits in the Cambridgeshire Fens. The borings by which the material for these was obtained were made in connexion with an archæological excavation undertaken with the object of establishing the stratigraphical position of prehistoric cultures of mesolithic and bronze age, of which surface indications appeared on this site at Peacock's Farm, Shippea Hill, Cambridge. The archæological results, based on the stratigraphic evidence, taken in conjunction with the evidence of the botanical investigation, have a far-reaching significance. A succession of three cultural horizons has been established, Early Bronze Age, Neolithic and Late Tardenoisian. The demonstration of such a succession on one site in a single vertical section is unique. Further, the association of each with a definite forest growth and vegetation context—a microlithic industry is here found in a peat deposit for the first time in Britain—opens the way to a number of precise chronological and cultural correlations. Hereby this Late Tardenoisian site is linked up with other finds in Britain, such as that at Skipsea, Yorks, and with Continental sites, such as Maglemose, Mullerup and Kunda.

IN other directions, also, this excavation has established important criteria for future investigation. Thus Neolithic *A*, the Windmill Hill culture, appears in this part of the country for the first time, not far removed from sites of Neolithic *B*, "Peterborough", finds. The application of the method of pollen analysis to the latter, when occasion arises, no doubt at an early date, should settle definitely the, at present, uncertain chronological relations of the two cultures. Mr. J. G. D. Clark's skilful reconstruction of the history of the site—a history of shrinkage of the area of settlement from period to period owing to the encroachment of the peat, with long periods of inactivity intervening—is an achievement which will hold a permanent place in the history of archæological investigation.

Excavations at Maiden Castle, Dorchester

EXCAVATIONS have been resumed at Maiden Castle, Dorchester, under the direction of Dr. R. E. Mortimer Wheeler, the initial objective being the investigation of the history of the ramparts. Digging at a point where the rampart rises to a height of fifty feet above the external ditch has revealed that the structure was composed of a core of carefully built up chalk rubble, faced on the inner side, covered with a layer of clay and chalk and surmounted by a parapet of limestone. The parapet was partially destroyed in ancient times, and eventually replaced by a timber palisade of which the socket holes have been found at a higher level. This palisade was constructed of stout timber posts at a distance of four or five feet apart and doubtless joined by woven hurdles. A cutting which has been made through the main defence shows evidence of five prehistoric periods in the history of the earthwork, the earliest being a palisaded bank of about ten feet, and culminating in an elaborate structure of masonry rising twenty feet above the internal camp. Beneath the original turf line a stone age factory floor was uncovered, on which were innumerable flakes from implement making, and a few scrapers and other tools. On an adjacent site a series of pits has been found, of which one is nine feet deep. These pits contained prehistoric pottery and a number of querns for grinding corn. Nearby was a group of ten loom-weights of chalk; and in the centre of this site post holes indicate the position of a large circular hut twenty-one feet in diameter. Finally, at the east gate of the camp three roads of late-Roman and post-Roman date have been examined and prehistoric road level has been reached.

Unknown Papua

SOME further particulars of the hitherto unknown people found in Papua by Mr. J. G. Hides (see NATURE, August 17, p. 251) are given in extracts from the official report and an article by the Australian correspondent of *The Times* in the issue of August 14. The report stresses the interest of the people in afforestation, the exactness of the division of the

fields for cultivation into squares and the straightness of the field drains, ranging from eight to ten feet in depth, the mode of burial in the open in wooden coffins surrounded by a picket fence, and the non-Papuan character of the people, shown especially in the lightness of their colour, their high cheekbones and finely moulded features. It is stated that, while anthropologists hesitate to express any opinion, owing to the lack of confirmation on investigation of previously reported marvels from the interior of Papua, Mr. E. W. P. Chinnery, Government anthropologist of Papua, has suggested their identity with the unknown tribes of Mount Hagen discovered in 1932 by Messrs. J. L. Taylor and M. Leahy (see NATURE, 134, 328; 1934). Mr. Hides, however, maintains that he has discovered a new people, but identifies tribes whom he afterwards encountered to the south-east with the people of Mount Hagen. His own theory is that the light-skinned people escaped years ago up the limestone cliffs after defeat in battle by other tribes and, discovering this fertile valley, settled, multiplied, and developed an entirely self-contained community. Until photographs are available, no judgment is possible, and until much more is known of the physical characters of the inhabitants of Papua, there is little utility in the discussion of theories of the survival of races. In the meantime Mr. Leahy and his brother confidently claim priority of discovery, and assert that light-skinned natives, common to many tribes, are pathological cases and usually exhibit symptoms of a mild form of St. Vitus's dance. Mr. M. Leahy, it is reported, is now on his way to submit photographs, films and other data to the Royal Geographical Society.

The Ovada Disaster

ONE of those calamitous occurrences which, from time to time, show the fallibility of human judgment in constructional work, has plunged northern Italy into desolation and mourning. Shortly after noon on August 13, a dam, which formed in the valley of the River Orba in Piedmont near the town of Ovada, the artificial lake, or reservoir, of Orsiglieto, containing a volume of 78,000,000 cubic feet of water, suddenly gave way and the impounded water, thus released, swept through the valley, destroying entire villages and causing widespread havoc and destruction. The number of lives lost is probably several hundred, and has been put so high as a thousand; but, in the absence of official statement, this estimate should, perhaps, be accepted with reserve. Four bridges were broken, one of them a railway bridge which collapsed a few minutes after a passenger train had passed over it. Nearly two miles of track has been torn up. The other three bridges were highway structures. Traffic was cut off, and telephonic and telegraphic communications interrupted. The flooded zone extended over an area about 2½ miles long and 1½ miles wide. It is stated that the disaster was the culmination of a series of violent thunderstorms which broke over southern Piedmont and central Liguria during the night of August 12 and the morning of August 13, and that in the Ovada region, adjacent to the dam, the precipitation reached the intensity of a 'cloudburst', converting streams and watercourses into raging torrents. The damage is roughly estimated in the neighbourhood of a million sterling. The dam, which is part of the undertaking of the Genoa Electrical Co., was built twenty years ago. Official instructions have been issued for its reconstruction.

Sir John Colbatch

UNDER the title of "An Early Forgotten Antiseptic Surgeon", who, as he maintains, has been most unjustifiably neglected by surgeons and medical historians, Prof. D. F. Fraser-Harris (*Med. Press and Circ.*, June 19, pp. 580–82) gives an account of John Colbatch, the author of a work published in 1704 entitled "Novum lumen chirurgicum or a New Light of Surgery wherein is Discovered a much more Safe and Speedy way of Curing Wounds than has hitherto been Practised". In this book, Colbatch describes the virtues of a "vulnerary powder", with which he had dressed wounds so successfully that in about four days all putrefaction was stopped. The composition of the powder he kept secret, and thereby incurred the reputation of a quack; but his comparison of its odour to the smell of roses suggested to Sir Watson Cheyne that it was ammonium salicylate. The chief scientific interest of Colbatch's work lies in the fact that, in addition to relating in detail the histories of fourteen cases of severe wounds in Flanders, where he was on military service, treated by the powder, he states that he performed experiments on about a hundred dogs to test its value, and was thus one of the earliest surgeons to experiment in the modern sense of the term. The date of Colbatch's birth is uncertain, but he died at an advanced age on January 15, 1729. He was knighted by George I in 1716.

Work of the Mellon Institute

THE twenty-second annual report of the Mellon Institute of Industrial Research, covering the period 1934–35, refers to extending activities in scientific, as well as in industrial, research. It is expected that the new building will be gradually occupied during 1935 and be complete by the end of the year. 62 industrial fellowships were in operation during 1934, requiring the services of 97 fellows and 48 assistants. 56 of these fellowships were in operation at the end of the year, and a high proportion of the fellowships are of five or more years standing. New fellowships during the year dealt with starch, stone, dried yeast, soya bean, etc., while fellowships terminated during the year covered cleaning, sugar, velvet, phosphates, paper finishing and vanadium. Special attention is directed to the studies on cinchona alkaloids conducted by the Department of Research in Pure Chemistry with the object of discovering compounds of therapeutic value in pneumonia. Fifty-nine such preparations have been tested, and biological and clinical data are being accumulated, some of which have been published. Studies on the preparation of apoquinine and its ethyl and hydroxyethyl ether are

practically ready for publication. A research on the action of sodium and sodamide has been completed and the preparation and alkylation of cinchona alkaloid oxides is being studied.

ON the industrial side, important results have been obtained in fundamental research on carbon blacks. These have led to the development of a method for the colloidal dispersion of carbon black pigments in lacquer vehicles, which gives black lacquers of markedly improved properties. Other fellowship studies have shown that, by the use of aqueous dispersions of carbon black, maximum darkening of concrete can be obtained with a minimum (2 per cent) of pigment, with as much as 25 per cent greater strength in the concrete. Aqueous dispersions of carbon black for these purposes are being sold under the name 'Hiblak'. Other researches have led to the development of a new enamelling process, new building materials, including improved plastic cements and new sulphur cements for use as binding agents or protective coatings in structures subjected to acids or corrosive solutions. New methods for testing refractories have been developed while the fundamental investigations on sodium hexametaphosphate which have led to the development of 'Calgon' have been continued. Under a fellowship for organic synthesis, methods for the preparation of glycol ethers have been developed and improved, new types of vinyl resins examined, and a group of polyethyleneamine derivatives of ethylenediamine has been developed for use in gas purification. New uses for ethylene and morpholine amines have been discovered, and important work on dental caries and on atmospheric pollution has also been carried out.

President Masaryk and Technology

UNDER the title "T. G. Masaryk a Technika" the Masaryk Academy of Work has published an account of President Masaryk's contacts with science and his keen interest in the technical applications of pure science. It will be recalled that his early experiences at the blacksmith's forge proved of value to him in after life when he was professor of philosophy and later still in his capacity as President of the Czechoslovak Republic. Quite early in his university career, he drew up a classification of the sciences (afterwards much used and adapted on the Continent), dividing them into theoretical (abstract and concrete) and practical. He placed them into seven groups, showing their mergings and affinities. Without being a specialist in any branch, Prof. Masaryk was well versed in scientific method and became something of an expert in detecting forgeries. He endeavoured to direct his philosophy and science towards improving the amenities of mankind. Two quotations from his writings make clear his attitude. "In former times we went after things which struck our fancy, we went in search of gold, the philosophers' stone, the elixir of life. Now we analyse water, air, the soil, manure, everything ordinary that surrounds us." "Without work we shall never have sufficient self-confidence. Work alone shows us what we are capable of. Work is self-recognition." The main part of the publication "T. G. Masaryk a Technika" has been compiled by Dr. V. Škrach; but a section on the origin of the Masaryk Academy of Work in 1920 is contributed by Prof. E. Zimmler, a former chairman. The Academy was founded as an autonomous scientific institution to organise technical work, making the best use of scientific advances and the natural resources of Czechoslovakia. It is composed of six sections: biological science and medicine, agriculture and forestry, building science, mechanics and electro-technics, chemistry and national economy. In its programme the Academy has combined all branches of engineering with the sciences, and has attempted to correlate research work and advances in the different sections so that they can be put to technical applications with the least possible delay.

Longer Trade Cycles

IN a pamphlet entitled "The Longer Trade Cycles" (Almquist and Wiksells Boktryckeri A-B., Stockholm, 1935), Axel F. Enström claims that a sixty year oscillation can be traced in a large number of price movements and production processes. An investigation of coal price quotations is said to have shown a complete sixty year period extending from about 1850 to 1910, while an examination of Sauerbeck's index number curve for wholesale prices disclosed the same cycle and in addition pointed to an earlier cycle of probably the same length. Valuable data illustrating price variations over a very long period, going back as far as the thirteenth century, are to be found in the Vicomte D'Avenal's monumental survey of French wheat prices, and an analysis of this material, according to Mr. Enström, shows a series of cycles of the order of magnitude of 60–50 years. If the D'Avenal curve is examined in the light of purely qualitative evidence which French, Swedish and European history as a whole can give regarding economic events in the eighteenth and nineteenth centuries, it will be found that the 60–50 year period of the curve accurately reflects the fluctuations in the European trade situation. The great technical inventions have as a rule been achieved in those periods which correspond to periods of depression in the superposed trade curve, that is, in periods characterised by a low price level.

Recent Developments in Genetics

THE Nobel lecture given by Prof. T. H. Morgan at Stockholm on June 4, 1934, is printed in the *Scientific Monthly* of July 1935. In it Prof. Morgan reviews the progress of genetics, with special emphasis on recent developments. The nature of the gene is discussed, the position each occupies in the chromosome being regarded as probably in the nature of a historical accident. Linkage, translocation, the pairing of chromosome threads and the recent work on salivary gland chromosomes all yield evidence regarding the nature of the genes, but the manner of their growth and division remains hidden. The physiological properties of the genes and their

relation to development are discussed at length. That embryological differentiation is not a sorting out of genes is clear, but present evidence is insufficient for deciding between various possible views of the ways in which the genes control development. (1) All genes may be active all the time, producing different results by their action on different parts of the egg cytoplasm. (2) Different batteries of genes may come into action at different stages of development, or at different rates, as Goldschmidt has postulated for sex-genes. (3) Possibly the kind of activity of the genes changes in response to the kind of protoplasm in which they lie. Finally, the relation of genetics to medicine is touched upon, and the importance of the developments in human genetics is recognised in relation to the inheritance of human defects, mental and physical. It is predicted that hundreds of cases of genetic linkage in man will be discovered.

Teaching the Value of Forests

ONE of the troubles in connexion with forestry and afforestation in Great Britain is the loss by the population of what, for want of a better term, has been termed the 'forestry sense'. Out in the Empire the difficulties of the forest officer arise from other causes. In each case it is sought by propaganda and education to teach the people the true value of the forest and its position in the economic structure of nations and the lives of the population. The Forestry Department in Trinidad is issuing a series of Forestry pamphlets "for teachers". No. 3 of the issue (Trinidad: Government Printer, Port-of-Spain, 1934) is entitled "Timber: Its Structure, Properties, Seasoning and Preservation" by Mr. R. L. Brooks, the conservator of forests. The pamphlet is illustrated by simple diagrams.

OF a somewhat different type, but having the same object in view, is the handbook to a temporary exhibition (May–September) based on the tree collections in the Department of Botany in the National Museum of Wales. This small brochure is entitled "Some Aspects of Forestry in Wales" (Cardiff 1935). The handbook has been prepared by Mr. H. A. Hydes. In a preface, Dr. Cyril Fox, the director of the Museum, writes: "The Forestry Act of 1919 authorised the formation of large State Forests and has thus broadened immeasurably the basis of forest ownership. Every man is now an owner of plantations, and should have some idea of how and why they are created and maintained. Such problems as the relative values of broad-leaved trees and coniferous trees as forest crops, and the scenic effect of planting introduced species along with native trees, which are now freely discussed in the Press, can only be understood in the light of at least a minimum of knowledge of the species concerned and of their relation to forestry in general." The exhibits are set out under the headings: Welsh forest botany, forest operations, forest pathology, wood anatomy and utilisation of forest produce. Among interesting exhibits are those relating to the beautiful woods of the Wye Valley, afforestation of sand dunes in South Wales, and the well-known plantations at Lake Vyrnwy, the chief reservoir for supplying water to the city of Liverpool. Those plantations now amount to 4,500 acres out of the total area of 5,000 acres which it is proposed to plant.

Literature of the Occult

ALTHOUGH the consideration of magic is a necessary prelude to the study of primitive religion, and, as such, lays claim to no inconsiderable share in the literature of anthropological science, it forms relatively only a small proportion of the vast accumulation of printed matter which has grown up in relation to magic in the larger sense, more especially in connexion with its manifestations in belief, theory and practice in medieval and modern times. Excepting historical and descriptive treatment, scientific analysis of this mass of material has barely begun. Eventually, when its evidence has been sifted and subjected to test, it should provide a valuable corpus of reference in the scientific investigation of manifestations of the 'marvellous'. In the meantime, a comprehensive library of occult literature is indispensable to research, especially in the detection of fraud. Unfortunately, the works which contain contemporary or early records of the facts are often both rare and costly. The University of London Council for Psychical Investigation is fortunate in having at its disposal the library of occult literature formed by Mr. Harry Price, from which a selection of five hundred rarities was on exhibition in December last (see NATURE, Dec. 15, 1934, p. 927). In 1929 Mr. Price published a catalogue of the greater part of his library, which contained 10,000 items. To this he has now added a supplement containing an additional 2,500 items acquired since that date (University of London Council for Psychical Investigation, Bull. 1: "Short-Title Catalogue of Works on Psychical Research . . . : From 1472 A.D. to the Present Day", pp. 112. London: 13D Roland Gardens. 2*s*. 6*d*.). It is embellished with nine illustrations, title-pages or cuts from rarer books such as Molitor's "De Lamiis et Pythonicis Mulieribus" (c. 1489) or "The Famous History of Friar Bacon" (1660), "very pleasant and delightful to be read" as is recorded on the title-page.

Power Farming in India

THE Imperial Council of Agricultural Research in India has issued, as Scientific Monograph No. 9, a report by C. P. G. Wade, on mechanical cultivation in India, prefaced by an approving foreword and an introduction, written by agricultural officers of the Government. The publication of the report in this form is of special interest, for the work has been inspired, financed and largely carried out by a commercial organisation, the Burmah-Shell Oil Storage and Distributing Co. It is difficult to see how the Government could have given official approval to work of this nature without raising awkward questions of precedent and policy, but for the existence of the Council, the constitution of which, as drawn up by the Linlithgow Commission on Indian Agriculture, was kept flexible and free from

certain restrictions necessarily observed by Government departments. Much of the work was done co-operatively with the agricultural departments of Provincial Governments. The scheme of work was conceived on broad and public-spirited lines; the Company cannot hope to recover its expenditure by any immediate increase in sales of oil; the most it can expect is to share, in common with other industries, in the increased general prosperity that will accompany any lasting improvement in the agricultural conditions of rural India. Although the greater proportion of Indian cultivators farm under peasant conditions, and cannot directly take up power farming, the question of co-operative use is worthy of attention; in addition, there seems a much larger scope for heavy power machinery on large holdings, for example, planters' estates, and in the reclamation and improvement, under Government supervision, of large areas. The report deals in detail with an extensive series of experiments on weed eradication by deep cultivation, on contract ploughing and on the analysis of costing data. The concluding chapters are devoted to a discussion of the design and performance of tractors and cultivation implements in relation to Indian conditions, and to the organisation of contract tractor ploughing.

Annual Report of Cheshunt Experimental Station

THE twentieth Annual Report (1934) of the Experimental and Research Station of the Nursery and Market Garden Industries Development Society, Ltd., has recently been published, from the Station, Turner's Hill, Cheshunt, Herts (pp. 107). The experimental work for 1934 is a continuation of the previous trials of varieties, fertilisers, soil heating, methods of sterilisation and other practices. Mycological investigations include a considerable section on virus diseases, and studies of fungi which attack chrysanthemums, roses, lettuce, carnations and other crops. A new insect parasite of the tomato moth caterpillar has been further described, pests of lettuce and chrysanthemum have received special study, whilst the more common thrips, symphilids and woodlice have also had attention. Insecticide and fungicide investigations have been continued, and the chemists have inquired into the potash content of 'blotchy' tomatoes and the manurial nutrition of chrysanthemums. The effects of light and water content on the growth of tomato plants, with studies on vernalisation, form the main subjects of physiological interest.

Use of Radium in Ireland

THE Irish Radium Committee has issued its report for the year 1934 (*Sci. Proc. Roy. Dublin Soc.*, **21**, No. 25, 1935. Separate issue). There was a small increase in the number of batches of radon tubes issued; but a decrease in the total quantity of radon, owing to the continued tendency towards the use of smaller doses, and a considerable increase in the number of cases treated. Little can be gathered from the report of the success or otherwise of the treatment, and an unsatisfactory feature is the fact that some 25 per cent of the patients treated could not be traced after their discharge from hospital.

Prof. P. O. Pedersen

THE friends of Prof. P. O. Pedersen, principal and professor of electrotechnics of the Royal Technical College, Copenhagen, have published in English some of his papers written in Danish to commemorate his sixtieth birthday, which occurred on June 19, 1934. The subjects discussed are mainly on the development of electrical communication technique, with special reference to contributions by Danes. Excellent work has been done by Gulstad, L. Lorenz, Jensen, C. E. Krarup, Johnsen and Rahbek, Valdemar Poulsen and Prof. Størmer. In a lecture delivered in 1933, Pedersen discusses the possibility of an application of scientific technical methods to other fields of research. The last paper given is on the depreciation of public utilities. In an appendix, a list is given of 97 publications by Pedersen.

New Discoveries of Permian Insect Fossils

ACCORDING to Science Service, Washington, D.C., an extensive deposit of fossil insects has been brought to light in a sandstone stratum near the mouth of the Mezer River on the Arctic coast of the U.S.S.R. A preliminary study of these remains has been made by Prof. A. G. Martynov, who finds that all Palæozoic families of insects are represented. Cockroaches are most abundant, but grasshoppers, dragonflies, scorpion flies and other primitive insect groups are also well represented, together with a small number of Coleoptera. An expedition of the Russian Academy of Sciences is at present making collections and studies in the region mentioned. It appears that these insect beds are contemporaneous with the well-known insect-bearing strata of Kansas, which have yielded an abundant fauna.

Japanese Biological Publications

WE have received vol. 3, Nos. 1 and 2 of *Botany and Zoology, Theoretical and Applied*, from Japan. It is a monthly publication, and these two numbers contain 364 and 176 pages respectively. The papers are illustrated and cover every phase of biology, but with the exception of one paper by Prof. Crozier, of Harvard University, they are entirely in Japanese. Only the scientific names and the names of Western authors are given in European characters, except one paper printed in Japanese using the Western alphabet! It seems a pity that papers, many of which are evidently of considerable general interest, should thus be cut off from Western science. Even Esperanto, which is occasionally being used by the Japanese in their scientific publications, would be preferable as a medium of publication if it is intended to attract the interest of biologists outside Japan.

Scientific Research in Australia

THE eighth annual report of the Commonwealth of Australia Council for Scientific and Industrial Research shows an increasing range of investigation and a growing number of requests for assistance

and advice. The difficulties which the Council had to face in its early years have now been largely overcome, and research stations have been provided and staffed, and are in full activity. The range of problems covers plants, insects, animal nutrition, soil, irrigation, forest and cold storage problems, all of which are important to Australian prosperity. The fear that activity would have to be curtailed owing to financial stringency necessitating a reduction in the Council's grant has been largely obviated by the readiness with which funds have been given by corporations, commercial companies and private persons.

Bibliography of Greenland

A BIBLIOGRAPHY of works on Greenland confined to authors born in Norway, as well as Icelandic authors prior to 1814, has been compiled by Mr. H. Vartdal and published as No. 54 of the *Skrifter om Svalbard og Ishavet*. The list runs to nearly eight hundred entries, and subsequent to 1721 is arranged according to subjects. A full index facilitates use. The list certainly has value, but would have been far more useful if it had been compiled without reference to the nationality of the authors, since the greater part of the works on Greenland are by Danish writers.

Bibliography of Seismology

MR. ERNEST TILLOTSON, 23, Roseville Road, Leeds, 8, writes with reference to notes on this subject in NATURE of June 29, p. 1070, and July 27, p. 138, that he has received from Mr. Ernest A. Hodgson, the author of the "Bibliography of Seismology", a number of forms to fill in with details of British publications on seismological subjects. With the aid of these forms, he hopes to keep the "Bibliography" as up to date as possible so far as authors normally resident in the British Isles are concerned. To this end Mr. Tillotson asks such authors to send to him at the above address any newly published seismological literature. It is probable that, whilst papers and books on seismology in the narrower sense have been included in the "Bibliography" already, papers on seismological prospecting or on such subjects as changes in level, or the growth of faults, or earthquake insurance, etc., may have been overlooked.

International Navigation Congress

THE sixteenth International Navigation Congress, which is to be held at Brussels on September 2–13, under the patronage of H.M. the King of the Belgians and the presidency of the Minister of Public Works, will discuss a number of questions and communications relating to inland and maritime navigation, including the regulation and treatment of rivers and canals and the protective works required at ports and harbours. The Belgian Government has invited all the States interested in the Association of International Navigation Congresses to send official delegations to Brussels for the occasion. The Secretary General of the Association is M. Joseph Millecam, 38 rue de Louvain, Brussels, from whom full particulars can be obtained of the meetings, and of the excursions to various installations and undertakings in Belgium and Holland.

Announcements

THE National Trust has accepted an offer by the Countess Buxton of nearly 150 acres of the South Downs at Newtimber Hill. The gift includes down and mixed woodland (mainly beech) with exceptionally fine views to the north and west, including Chanctonbury and Cissbury Rings.

THE fifteenth International Congress of Medical Hydrology, Climatology and Geology will be held at Belgrade in October 1936 under the patronage of the Prince Regent. Further information can be obtained from the general secretary, Prof. M. Neskovitch, 3 rue Takowska, Belgrade.

THE second International Congress of Mental Hygiene will be held in Paris on July 27–31, 1936, with Prof. H. Claude as president of honour and Dr. E. Toulouse as president. The official languages will be French, English, German, Italian, Spanish and Portuguese. Typewritten copies of communications must be sent to the president of the executive committee, Dr. René Charpentier, 119 rue Peronnet, Neuilly-sur-Seine, France, not later than November 1, 1935. The subscription, which is 125 francs, should be sent to the treasurer, M. R. Demaclus, 27 rue de Londres, Paris.

THE first number of a new quarterly, *Annals of Science*, devoted to the history of science since Renaissance times, will be published by Messrs. Taylor and Francis, Red Lion Court, E.C.4, on January 15, 1936 under the editorship of Dr. D. McKie of University College, London, joint author of "The Discovery of Specific and Latent Heats"; Prof. Harcourt Brown, of Washington University, St. Louis, U.S.A., author of "Scientific Organisations in 17th Century France"; and Mr. H. W. Robinson, assistant librarian of the Royal Society of London, co-editor of "The Diary of Robert Hooke".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A junior scientific officer (physicist) at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Aug. 27).

A research chemist in the Department of Agriculture, Straits Settlements and the Federated Malay States—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1. (Aug. 31).

A lecturer in the Civil and Mechanical Engineering Department of the Woolwich Polytechnic, S.E.18—The Secretary (Aug. 31).

An assistant lecturer in agriculture to the Cornwall County Council Education Committee—The Secretary, Education Department, County Hall, Truro (Sept. 10).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 303.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Statistical Tests

As the originator of the P, χ^2 test, I should be glad if you can spare me space for some reply to Mr. Buchanan-Wollaston[1]. I should like first to state that I am in no way responsible for all the applications which have recently been made of that test, and do not accept the validity of some of the applications which Prof. R. A. Fisher has made of it in his well-known textbook. I am not concerned with his position and leave him to defend it. My own position is as follows:

(i) I introduced the P, χ^2 test to enable a scientific worker to ascertain whether a curve by which he was graduating observations was a reasonable 'fit'. On this account, and as a measure of success in graduation, I termed it a 'goodness of fit' test. It had no special relation to the normal curve or to any other curve. The scientific worker in the past had chosen any curve he pleased to graduate his observations, but he rarely applied any measure of its aptness, beyond looking at a graph to 'see' whether it was a 'good fit'. The pages of the Royal Society *Transactions* and *Proceedings* are evidence enough of this fact.

(ii) As a measure of 'goodness of fit', the P, χ^2 test does enable one to compare the relative advantages of any two graduation curves. But I personally have never assumed that the better graduation curve was the one from which the material had actually been drawn.

(iii) I have shown both theoretically and experimentally that there is a high correlation between the 'goodness of fit' of a graduating curve to a *sample*, and the 'goodness of fit' of that curve to the parental population from which the sample has been drawn. Accordingly, *if the sample be large*, the graduating curve may be taken as representing reasonably the parent population.

(iv) I have shown that, when dealing with *small* samples, no real distinction can be made between sampling from, say, a normal curve or a rectangle. It requires at least a sample of more than a 100 individuals to determine whether it would be best to use a rectangle or some other curve! I have repeatedly insisted that little can be learnt of the superiority of one graduating curve over another, if the sample be not of considerable size, say, well beyond the 100 mark.

All this proves that the P, χ^2 test has no relation to Mr. Buchanan-Wollaston's remark that: "The fact that British methods 'work' is due to the prevalence in Nature of distributions *similar* to the Gaussian [*sic*] rather than to any peculiar virtue in the methods themselves". It would appear from this remark that my critic and his 'Continental workers' have never gone beyond applying the test to questioning whether the normal curve was a reasonable graduation curve!

(v) The only relation of the P, χ^2 test to the normal curve arises from the use of that curve in the analysis to replace binomials by normal curves. Such replacement is not legitimate *theoretically*, when in the binomial $(p + q)^n$, p is very much larger or very much smaller than q. This has led to the practice of clubbing together small 'tail' groups. But practically there is, *as a rule*, very small difference in the resultant P's, whether we club tail groups and reduce the number of cells, or work P out for the full number after considering outlying individuals which may be anomalous. I do not therefore understand Mr. Buchanan-Wollaston's remark that: "It seems only reasonable that but a small part of the centre of the χ^2 distribution should be used as a test of *fit*". In a large percentage of cases to which χ^2 may be applied in biometric and biological investigations, there are no 'tails', that is, no small categories at the terminals. If we wish to avoid the assumption that at such 'tails', where they exist, it is legitimate to replace binomials by normal curves, then the P, λ_n test can be applied.

(vi) From my point of view, the tests are used to ascertain whether a reasonable *graduation* curve has been achieved, not to assert whether one or another hypothesis is true or false. If we narrow ourselves down to asking whether a normal curve will reasonably *graduate* the material and find it does, are we to follow it up by asserting that either sample or parent-population follows a normal distribution? I should say: Certainly *not*. I have never found a normal curve fit anything if there are enough observations! The astronomical data provided to prove that errors of observation follow normal curves are pitiably scanty, and if proper tests are applied usually show that they do not! The fact is that all these descriptions by mathematical curves in no case represent 'natural laws'. They have nothing in this sense to do with 'hypothesis' or 'reverse of hypothesis'. They are merely *graduation curves*, mathematical constructs to describe more or less accurately what we have observed.

(vii) The reader will ask: "But if they do not represent laws of Nature, what is the value of graduation curves?" He might as well ask what is the value of scientific investigation! A good graduation curve—that is, one with an acceptable probability—is the only form of 'natural law', which the scientific worker, be he astronomer, physicist or statistician, can construct. Nothing prevents its being replaced by a better graduation; and ever bettering graduation is the history of science.

What is the use of good graduation curves? Ask the actuary! Such curves enable a mass of details to be summed up with reasonable probability in the knowledge of a few constants, and from those constants we obtain new knowledge of the properties of the mass. Take only the importance of a life table graduated by the Makeham-Gompertz curve and consider, what new knowledge flows from it. But

after all, it is only a graduation curve and it is open to anyone to find a better one! If Continental statisticians in the bulk do indeed hold the views of Mr. Buchanan-Wollaston, it can only be that they have not really studied and grasped the fundamental literature of the subject.

KARL PEARSON.

Biometrika Office,
University College,
London.

[1] NATURE, 136, 182, August 3, 1935.

Blood Group Inheritance

SEVERAL theories of the inheritance of human blood groups have been proposed, but none has been completely satisfactory.

(i) The theory of two independent pairs of Mendelian factors, proposed by Hirschfeld and von Dungern[1], leads to the equilibrium condition

$$ps = qr$$

where p, q, r, s are the frequencies of the groups AB, A, B, O. But[2,3] in all observations of the distribution of the groups,

$$ps < qr.$$

(ii) The corresponding condition arising from Bernstein's multiple allelomorph theory[2,5] is

$$\sqrt{q+s} + \sqrt{r+s} = \sqrt{s} + \sqrt{p+q+r+s}.$$

This is satisfied with sufficient accuracy in all observed distributions, but this theory fails to account for the observed occurrence of a small percentage of groups AB and O in the offspring of $AB \times O$ matings.

(iii) Bauer[4] proposed to account for this by the mechanism of 'crossing-over'. His theory is the subject of criticisms in a paper now in course of preparation, in which we shall show that the following theory, which is not exactly what Bauer stated, is the one to which his premises should have led:

(iv) The blood groups are inherited in association with two linked pairs of Mendelian factors, A, a, B, b. There are thus four kinds of gametes,

$$AB,\ Ab,\ aB,\ ab;$$

and ten genotypes:

$AB.AB$, $AB.Ab$, $AB.aB$, $AB.ab$, $Ab.aB$—phenotypically group AB;
$Ab.Ab$, $Ab.ab$—group A;
$aB.aB$, $aB.ab$—group B;
$ab.ab$—group O.

If crossing-over takes place, we may suppose that there is a certain probability ω that the genotype $AB.ab$ transmits the gametes Ab and aB normally transmitted by the genotype $Ab.aB$; and the same probability of vice versa.

In Bauer's theory (iii), ω is about 0·055. If $\omega = 0$ and the first four genotypes in the above scheme are initially (and therefore permanently) absent from the population, the theory (iv) reduces to (ii). With $\omega = \frac{1}{2}$, (iv) is indistinguishable from (i).

The theory we actually propose is (iv) with $\omega = 0$. (This also gives results indistinguishable from (i) in all matings which do not involve the distinction between the genotypes $AB.ab$ and $Ab.aB$.) It is unnecessary to postulate crossing-over, since with this theory $AB \times O$ matings would anyhow give rise to some AB and O offspring. But, further, crossing-over is definitely precluded, since it may be shown to lead to the same equilibrium condition as the theory (i). There is no corresponding condition when $\omega = 0$; that is to say, any distribution of the groups can be in stable equilibrium provided that the genotypes are suitably distributed. But for equilibrium distributions in which AB is rare compared with the other groups, the theory approximately coincides with (ii); and therefore, as in that theory,

$$\sqrt{q+s} + \sqrt{r+s} = \sqrt{s} + \sqrt{p+q+r+s}$$

approximately. This, as already pointed out, agrees with observation, and therefore (since p is generally about 5 per cent) corroborates the new theory.

The rare recorded occurrences[5] of A offspring from $O \times O$ matings, of AB and B from $A \times O$, and of AB and A from $B \times O$, cannot be accounted for genetically by any of these theories. They must still be put down to mistaken parentage or faulty technique in group determination.

Thus the theory proposed has all the advantages of its predecessors, with fewer disadvantages.

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I. M. H. ETHERINGTON.

Department of Mathematics,
The University,
Edinburgh.

July 6.

[1] Hirschfeld and von Dungern, *Z. Immun. Exp. Therapie*, 6, 284; 1910.
[2] Lattes, "The Individuality of the Blood". O.U.P. (1932).
[3] Bernstein, *Z. Ind. Abst u. Vererb.*, 37, 237; 1925.
[4] Bauer, *Klin. Wochenschr.*, 7, 1588; 1928.
[5] Furuhata, *Japan. Medical World*, 7, No. 7, 1927.

Technique of Factor Analysis

FACTOR analysis is a subject upon which Prof. G. H. Thomson, Dr. Wm. Brown and others have frequently written letters to NATURE. This analysis is concerned with a selected population of n individuals each of whom has been measured in m tests. The $(m)(m-1)/2$ intercorrelations for these m variables are subjected to either a Spearman or other factor analysis.

The technique, however, can also be inverted. We begin with a population of n different tests (or essays, pictures, traits or other measurable material), each of which is measured or scaled by m individuals. The $(m)(m-1)/2$ intercorrelations are then factorised in the usual way.

This inversion has interesting practical applications. It brings the factor technique from group and field work into the laboratory, and reaches into spheres of work hitherto untouched or not amenable to factorisation. It is especially valuable in experimental aesthetics and in educational psychology, no less than in pure psychology.

It allows a completely new series of studies to be made on the Spearman 'central intellective factor' (g), and also allows tests to be made of the Two Factor Theorem under greatly improved experimental conditions. Data on these and other points are to be published in due course in the *British Journal of Psychology*.

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London, W.C.1.

June 28.

Rainfall-Evaporation Ratio in Relation to Locust and Grasshopper Outbreaks

A WIDESPREAD outbreak of the migrating grasshopper, *Chortoicetes terminifera*, Walk., occurred in Australia during 1933–35. Reports show that, in South Australia, small, local swarms appeared during the summer 1932–33 in certain districts in the pastoral country about 150 miles north of the 10 in. annual isohyet (see Fig. 1). During 1933–34 swarms were widely distributed and in some areas extended about 100 miles south of this rainfall line. During 1934–35 they became generally distributed southwards over the agricultural areas of the State.

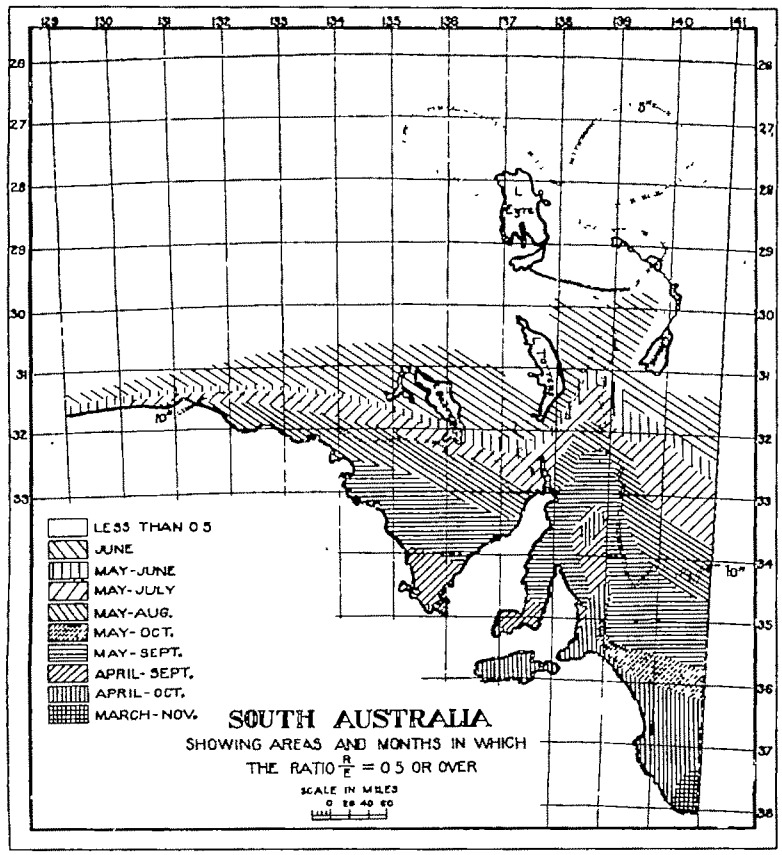

FIG. 1.

These widespread invasions develop only at irregular intervals of several years; the presence of the insects in numbers, in the southern areas of the State, is temporary. Restricted outbreaks occur more frequently in certain areas situated immediately north of the 10 in. isohyet; in some instances the swarms may extend southwards into the wheat belt.

Local grasshopper swarms appear from time to time during the summer months in the pastoral country north of the 10 in. isohyet; their appearance is associated with summer rains. The endemic centres of *Ch. terminifera* appear to be in this region but they have not yet been defined. The average annual rainfall over this portion of the State is about 5–10 in. (see Fig. 1); there are wide fluctuations about the mean from year to year, resulting in prolonged periods of drought; much of the rain falls during the summer months. The southern portion of the State includes the better rainfall agricultural areas. Precipitation is more reliable and most of the rain falls during the winter period (May–October), the summer being hot and dry.

Ch. terminifera lays its eggs in particular soils to a depth of about 2 in. Dryness of the soil results in an enforced diapause in the egg stage, but experimental data are not yet available for this species: Faure[1] showed with *Locustana pardalina*, Walk., in South Africa, that the eggs remained viable in dry soil for 37 months. Soil moisture is determined primarily by rainfall in relation to evaporation (R/E). I have already shown how mean monthly values for the ratio R/E may be computed for Australia[2]. In the accompanying map of South Australia (Fig. 1), the months and approximate areas are shown in which the mean monthly values for R/E are 0·5 or more. It is considered tentatively that these values, in South Australia, give adequate soil moisture for the development of the eggs of *Ch. terminifera* provided temperature is suitable. It may be noted that, in countries where data for evaporation are not available, the ratio of precipitation to atmospheric saturation deficit may be used as an index of aridity; this ratio was originally employed by Meyer in 1926 (vide Prescott[3], 1934).

The mean monthly temperature for the coldest month (July) over the greater part of South Australia does not fall below 50° F.; over the elevated districts of the agricultural areas, it varies between 45° and 50° F. The temperature value for the developmental zero of the eggs of *Ch. terminifera* has not yet been determined. It is evident, however, that in South Australia temperatures will not be below this value for long periods. Eggs laid in summer, in the southern portion of the State, will hatch in autumn or early winter, particularly if the wet season opens early; this period is unfavourable for the insects, and mortality is heavy; this was the case in the autumn of 1935. When the wet season opens late, the insects hatch out nearer to the spring months, particularly in the northern hatched areas shown on the map; this was the case in 1934, and the survival rate of the insects in the spring was high. The favourableness of the conditions will vary according to the character of the wet season. In the northern pastoral areas monsoonal rains in the summer months may cause creeks and flats to be temporarily flooded; adequate moisture will be available for a time, for development of the eggs and growth of ephemeral grasses for the insects. Apart from weather factors, soil type and vegetation are important in relation to the distribution of the endemic centres of *Ch. terminifera*.

It would appear, therefore, that temporary invasions of the southern portion of South Australia by *Ch. terminifera* are closely correlated with the rainfall of particular seasons. The extent of the invasion

depends largely upon the duration of a combination of favourable conditions in the endemic areas and in the southern portions of the State. A detailed study of the ecology of the species is in progress.

JAMES DAVIDSON.

Waite Research Institute,
University of Adelaide.
June 15.

[1] J. C. Faure, *Bull. Entom. Res.*, **22**, 393; 1932.
[2] J. Davidson, *Aust. J. Exp. Biol and Med Sci.*, **11**, 59; 1933.
Trans. Roy. Soc. South Australia, **58**, 33; 1934.
[3] J. A. Prescott, *Trans. Roy. Soc. South Australia*, **58**, 48; 1934.

Wood Hemicelluloses

SINCE the isolation of 'starch' from wood[1] another product has been obtained from the cell walls of oak sapwood which, instead of giving the usual blue colour with iodine, gives a royal purple colour reverting to blue on standing. This latter substance is more closely allied to hemicellulose *A*[2] than the starch of the cell contents since it appears to be made up of:

Uronic and aldobionic anhydride residues	(14 per cent approx.)
in addition to—	
Anhydro-xylose	(10 per cent approx.)
and	
Anhydro-glucose residues ..	(75 per cent approx.)

Attempts are now being made to prepare starch from oak leaves in quantities sufficient for analysis. A small sample already obtained has yielded on hydrolysis with 12 per cent hydrochloric acid an amount of carbon dioxide corresponding to 24·4 per cent of uronic anhydride. These results appear to permit of the formulation of the hypothesis that certain of the hemicelluloses of oak wood are derived from starch in a series of steps involving the oxidation of primary alcoholic groups and the subsequent formation of anhydro-xylose residues by decarboxylation. If the hypothesis is correct, the term 'hemicellulose' can no longer be applied to the acid polysaccharides in question, and the alternative general term 'amylo-uronides' is therefore suggested. If the furfuraldehyde-yielding complexes associated with the cellulose of wood are derived therefrom by a similar series of reactions, the term 'hemicellulose' might still be reserved for them.

W. G. CAMPBELL.

Department of Scientific and Industrial Research,
Forest Products Research Laboratory,
Princes Risborough, Aylesbury, Bucks.
July 6.

[1] Campbell, *Biochem. J.*, **29**, 1068; 1935.
[2] O'Dwyer, *Biochem J*, **28**, 2116; 1934.

Amorphous Antimony

IN a previous letter[1], I showed that a thin layer of antimony produced by distillation in a high vacuum is amorphous. This conclusion was drawn from the fact that the electron diffraction pattern consisted of broad bands always showing exactly the same appearance (width, intensity, etc.); this could scarcely be understood if the state were only colloidal. The following researches corroborate and extend this view:

When such an amorphous layer is heated to 120°–150° C. (the thinner layers requiring the higher temperatures), the diffraction pattern changes into the ordinary powder diagram of antimony, consisting of a large number of sharp rings. If the original layer was *very* thin, the rings after heating remain more or less broad as a consequence of the small size of the crystallites; the difference from the original amorphous pattern is, however, unmistakable even in this case. In all cases the crystallites produced by heating are oriented at random, differing in this respect from those formed by spontaneous crystallisation at room temperature, described previously.

These results throw a new light on the so-called 'explosive' state of antimony, discovered by Gore almost a century ago. As is well known, this state is obtained by electrodeposition; in this case there is no upper limit to the thickness of the deposit obtainable. The diffraction patterns of such layers[2] proved to be identical with those of amorphous antimony described above. *This shows that Gore's explosive antimony is essentially identical with our pure amorphous antimony.* Explosive antimony is known, however, to include some 10 per cent of the salt electrolysed; this may be present as thin films (probably monomolecular) surrounding small quantities of pure amorphous metal, thereby inhibiting their crystallisation.

From this picture, it may be expected, for example, that the electric resistance of explosive antimony will not be determined by the metallic parts but mainly by the salt films[3]. Experimentally, I have found values for the resistivity about 100 times that of ordinary antimony, and other observers[4] even give a factor 1000. These high values, as well as their irreproducibility, are arguments in favour of the view put forward above. Other properties, however, might be less sensitive to the presence and quantity of inclusions, and should then be the same as for pure amorphous antimony. As such we shall here consider the heat of crystallisation and the diamagnetic susceptibility:

It is well known that explosive antimony derives its name from the fact that it may change more or less explosively into ordinary antimony, or, as we may now say, it crystallises more or less explosively. This 'explosion' may be caused by scratching or by heating to about $97° \pm 2°$ C. Now the heat of crystallisation liberated in this process, measured by E. Cohen and Th. Strengers[5], is found to be 20 cal./gm. This is of the same order of magnitude[6] as the heat of crystallisation from the liquid at the melting point (24 cal./gm.). I have measured the diamagnetic susceptibility of explosive antimony and find that it increases markedly when the transition to ordinary antimony is brought about. This is again in agreement with the change in diamagnetic susceptibility at the melting point. *The two results together strongly suggest that the explosive (amorphous) state of antimony is the supercooled liquid state.*

The experiments were made in collaboration with Mr. P. Teunissen in the laboratory of Prof. D. Coster. The full paper is to appear in *Physica*.

J. A. PRINS.

Natuurkundig Laboratorium
der Rijks-Universiteit,
Groningen.
July 22.

[1] NATURE, **131**, 760; 1933.
[2] I took photographs with copper *K*-radiation; see also H. Kersten, *Physics*, **2**, 276; 1932.
[3] Included impurities may exert an analogous effect in sputtered layers, described by H. Zahn and J. Kramer, *Z. Phys.*, **86**, 413; 1933.
[4] H. v. Steinwehr and A. Schulze, *Z. Phys.*, **63**, 815; 1930.
[5] *Z. phys. Chem.*, **52**, 129; 1905.
[6] G. Tammann und W. Müller, *Z. anorg. u. allg. Chem*, **221**, 109, 1934.

Raman Effect in Solutions of some Amino Acids

THE purpose of this letter is to report some measurements of Raman frequencies in solutions of glycine, alanine, tyrosine and cystine, which have been observed as a preliminary to the development of a spectroscopic method of analysis for molecules of this class.

An air-cooled quartz-capillary mercury arc furnished the exciting light, filter solutions of sodium nitrite and praseodymium ammonium nitrate permitting excitation by the 4358 A. line. The spectrograph was a two-prism glass instrument having a dispersion of 23 A./mm. at 4500 A.

Solutions (in water) of samples of glycine and alanine which had been recrystallised several times to remove impurities exhibited some fluorescence; this, however, decreased upon still further recrystallising. Introduction of a small amount of potassium iodide to these solutions quenched the fluorescence very effectively.

The observed Raman frequencies (in cm.$^{-1}$) together with visual estimates of the relative intensities are as follow:

Glycine (15 per cent solution in water, 10 per cent KI):—506 (3), 899 (8), 1036 (4), 1112 (2), 1332 (8), 1411 (10), 1445 (4);

Alanine (15 per cent in water, 8 per cent KI):—528 (2), 851 (6), 1305 (4), 1358 (5), 1383 (1), 1417 (10), 1466 (6), 1715 (4);

Tyrosine (5 per cent in 0·9 N HCl):—646 (3), 844 (9), 1216 (6), 1359 (4), 1448 (1), 1620 (10);

Cystine (8·33 per cent in 1·1 N HCl):—503 (10), 670 (10), 1633 (3), 1736 (3).

These lists are not to be regarded as complete for the spectral region covered, as weaker lines have been no doubt obscured by scattered continuous radiation from the mercury arc. The range of error of the measurements is roughly $\pm$ 3 cm.$^{-1}$.

To test the effect of varying the concentration, three solutions of glycine having concentrations of 7·5, 15 and 22·5 per cent were examined. The Raman lines showed no shift in position greater than 2 cm.$^{-1}$. Varying the amount of potassium iodide in these solutions from zero to 40 per cent also produced no shift greater than the error of measurement.

NORMAN WRIGHT.
W. C. LEE.
Department of Physics,
University of Michigan.
July 10.

Initiation of the High-Frequency Discharge

WHEN the gas hydrogen in a wide tube is excited by means of a high-frequency alternating potential $V\sin 2\pi nt$, applied between two parallel plate electrodes, the relation between the sparking potential $V_s\sin 2\pi nt$, the gas pressure p, and the inter-electrode distance d for values of pd in excess of the critical value is of the simple form $V_s = A + Bpd$, where B is a gas constant and A depends upon the frequency n and the electrode surfaces[1].

This form of Paschen's law is consistent with the hypothesis that the peak potential V_s just before the initiation of the discharge is made up of two parts, (1) an electrode fall V_E and (2) a uniform field in the gas Bp. At pressures considerably in excess of the critical value, it may be assumed that V_E occurs in a very small fraction of the distance d. Then V_E will be approximately equal to A.

In the accompanying diagram (Fig. 1) an experimental curve is shown which exhibits the variation of V_s with p in a tube the electrodes of which were of copper, 8 cm. in diameter and 2·58 cm. apart. The frequency of the applied potential was 2·03 × 10^7 c.p.s. This curve is typical of those which have been determined for frequencies between 8 × 10^6 c.p.s. and 9 × 10^7 c.p.s. It can be explained in terms of (1) ionisation by positive ions at the cathode and (2) ionisation by electronic impact in the gas. The former is connected with the electrode fall (72 volts) and the latter with the gradient B = 21·6 volts/cm./mm. of mercury.

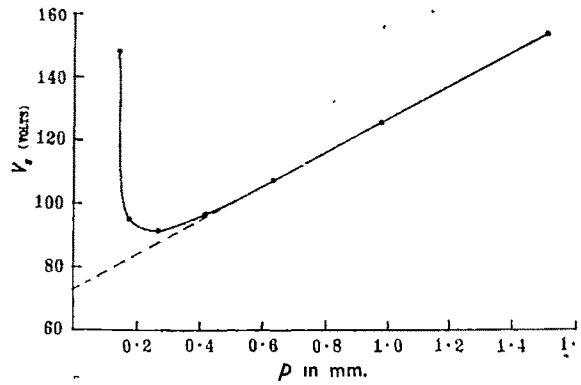

FIG. 1.

If it is assumed that a typical free electron moves under the action of the electric field so that $m\dot{x} = Ee\cos(2\pi nt - \varphi)$ and that a discharge occurs when the electron gains its ionising velocity at a given distance $L = K/p$ from its starting point, it can be shown that the mode of variation of E with p for a discharge is,

$$E = \frac{\pi n\sqrt{\dfrac{2V_0}{e/m}}}{\sin\dfrac{2\pi nK}{p\sqrt{(2V_0e/m)}}}. \quad . \quad . \quad . \quad (1)$$

For large values of p, $E = V_0p/K$, giving the constant gradient $B = V_0/K$.

When various experimental curves are examined by these hypotheses, the following facts emerge:

(*a*) The ionisation potential V_0 of the gas is correctly predicted.

(*b*) The value of K is much larger than that deduced from the kinetic theory on the assumption that L is the electronic mean free path.

(*c*) In discharges at *all* high frequencies, the critical pressure p_s is such that $d = K/p_s$ where K is calculated from the gradient V_0/K.

This last fact indicates that the minimum E predicted by equation (1) is not in general observed. Owing to the relatively large electrode fall, the equation only holds at the minimum for certain frequencies or for tubes in which d is very large. Fig. 1 is drawn for a value of n for which the theory of equation (1) holds very exactly down to the critical pressure.

A detailed account of the experiments which have led to these conclusions, and of others relating to the initiation of discharges by means of constant potentials, will be published elsewhere in due course.

JOHN THOMSON.
Natural Philosophy Department,
The University, Glasgow.
July 1.

[1] J. Thomson, *Phil. Mag.*, 18, 696; 1934. The value given for B in this paper is in error, due to a mistake in the estimate of a capacity. The correct value for the experiments there described is 26 volts/cm./mm.

Multiplanar Cyclohexane Rings

IN 1931 I published a paper in the *Journal of the Indian Chemical Society* in which the four isomeric modifications of 4-methyl cyclohexane-1-carboxy-1-acetic acid were described[1]. In a recent publication S. Goldschmidt and G. Grafinger[2] observed that they could not isolate the acid *B*, as described above, and consequently they concluded that actually 4-methyl cyclohexane-1-carboxy-1-acetic acid existed in only two modifications, one melting at 137° and the other at 174°. It appeared to me rather strange that the work, which was repeated a number of times before publication, should be altogether wrong. It was, therefore, considered desirable to get the work repeated once more in my presence, and this has accordingly been done now by a student of mine, Mr. Asutosh Mukherji, with the result that we found no difficulty whatever in isolating all the four modifications of the acid as described before. It may, however, be recorded here that the solubility of the ammonium salt of the acids *A*, *B* and *C* in absolute alcohol is as follows :

One gm. of acid *A* dissolves in 75 c.c. of boiling absolute alcohol.
" " " *B* " " 45 " " " "
" " " *C* " " 34 " " " "

The quantity of the absolute alcohol must, therefore, be carefully regulated, otherwise, if acids *B* and *C* come out together in alcoholic solution, it becomes very difficult to separate them from one another. Regarding the suggestion of Goldschmidt that the acid *B* may be a eutectic mixture of acids *A* and *C*, it appears to be untenable and not based on experimental evidence. The mixture of the acids *A* and *C* gave at no time any sharply melting substance which would melt at 129° or near about it as the acid *B* does. The same is true for the acid *D* also. It is difficult to say whether it is the unsuitable method of separation adopted by the German chemists that is responsible for their failure to get the acid *B* and *D*. It may incidentally be mentioned that these isomers are not at all similar to any of those isolated from the *para* or *ortho* methyl cyclohexanone. Although all the expected isomeric acids from these latter ketones have not yet been isolated, the work so far completed will be published very shortly elsewhere.

The *p*-methyl cyclohexanone and other ketones of the series are now being prepared with different catalysts in order to see if the quality of the ketones has anything to do with the formation of the isomeric acids.

M. QUDRAT-I-KHUDA.

Presidency College,
Calcutta.
June 28.

[1] See NATURE, 127, 253; 1931.
[2] *Ber.*, 68, 279.

Vapour Pressure of Hexadeuterobenzene

IT has recently been recorded[1] that the vapour pressure of deuterium iodide is slightly, but definitely, greater than that of protium iodide, a behaviour qualitatively analogous to that exhibited by the two hydrogen fluorides[2]. This type of anomaly is, therefore, not confined to substances which are generally recognised as associated in the vapour state[3].

We know an even clearer example : the vapour pressure of C_6D_6 is greater than that of C_6H_6 for the whole temperature range 0°–80° C. (below the freezing point, 6·8°, the liquid is supercooled) over which we have measured it. The boiling point of C_6D_6 at normal pressure is 0·8° lower than that of C_6H_6, contrary to a recent claim that the former is higher[4].

C. L. WILSON.

University College,
London.
July 29.

[1] Bates, Halford and Anderson, *J. Chem. Phys.*, 3, 415; 1935.
[2] Claussen and Hildebrand, *J. Amer. Chem. Soc.*, 56, 1820; 1934.
[3] Lewis and Schutz, *ibid.*, p. 493. Wilson, *J. Chem. Soc.*, 492: 1935.
[4] Clemo and McQuillen, *J. Chem. Soc.*, 851; 1935.

Inverse Probability

IN my letter[1] of May 4, I was not defending Eddington's solution of his problem in inverse probability, but was attacking Dr. Dingle's discussion[2] of his own simplified problem : If *A* and *D* each speak the truth once in three times independently, and *A* says that *D* lies, what is the probability that *D* speaks the truth ? In his discussion Dr. Dingle said, "Sir Arthur's treatment effectively combines the knowledge of *D*'s moral character with that of *A*'s. But is it not clear that such combination is purely fictitious ? From our knowledge of *D* the probability is $\frac{1}{3}$; from our (independent) knowledge of *A* it is $\frac{2}{3}$. The results are inconsistent because the data are independent ; we are effectively defining probability in different ways". It should be clear from my solution of Dr. Dingle's problem that the answer is neither $\frac{1}{3}$ nor $\frac{2}{3}$, but $\frac{1}{2}$, and nothing else. There are really no inconsistencies, as I showed by drawing up the association table.

I do not agree with Dr. Dingle's more recent[1] assertion, that one must ". . . either (*a*) define probability in a purely mathematical way and so obtain a unique solution which may be both consistent and correct . . . , or (*b*) refrain from calling meaningless mathematical functions 'probability', and then obtain two solutions to each problem". My treatment used "probability" in the simplest and perhaps most significant meaning of the word. Out of $4N/9$ cases where *A* says that *D* lies, *D* actually lies $2N/9$ times and tells the truth $2N/9$ times. Does Dr. Dingle seriously maintain that the ratio, $2N/9 \div 4N/9 = \frac{1}{2}$, is a "meaningless mathematical function", or that, given that our case is one of these $4N/9$ cases, there is any lack of significance in saying that the probability that *D* tells the truth is $\frac{1}{2}$?

Although I cannot subscribe to Dr. Dingle's arguments, I am inclined to agree with him that Eddington's solution was incorrect. The data supplied by Eddington do not seem to me to be sufficient to allow one to write down the class frequencies in a contingency table.

T. E. STERNE.

Harvard College Observatory,
Cambridge, Mass.
July 11.

[1] NATURE, 135, 1073; 1935.
[2] NATURE, 135, 451; 1935.

THE point at issue between Dr. Sterne and myself is ultimately whether consistency is equivalent to significance or not. Evidently it is not easy to clear it up in a few sentences, and the Editor has invited me to write an article on the whole question of probability which will appear in NATURE shortly.

I will only say here that in the passage which Dr. Sterne quotes from my review, I called the results "inconsistent" because they were ostensibly different values for the same thing—"probability". I thought it would be understood that if those two things were called by different names, and made no pretensions to be the same thing, there would be no inconsistency. In other words, I did not attribute inherent inconsistency to the problem but to two possible ways of defining the solution.

HERBERT DINGLE.

Imperial College of Science,
S.W.7.
July 31.

Constitution of the Prosthetic Group of Catalase

KARL ZEILE[1] in 1930 was the first to provide evidence that the catalytic activity towards hydrogen peroxide of purified preparations obtained from liver and from marrow seedlings is intimately connected with a pigment exhibiting the spectral behaviour of a complex consisting of a hæmatin group—the iron being stabilised in the trivalent state—and of a colloidal component. The position of the absorption bands of the pyridine hæmochromogen and of the porphyrin, obtained in solution by treatment with hydrazine and acetic acid, led him to conclude that the hæmatin contained in the enzyme complex was either identical with, or was an isomer of, the prosthetic group of natural hæmoglobin.

Solutions rich in catalase were obtained by a method embodying fractional alcohol precipitation, removal of hæmoglobin by chloroform denaturation, adsorption of the enzyme on alumina gel, elutriation with secondary sodium phosphate, and concentration by acetone-CO_2-treatment in the cold. The active hæmatin-protein complex was split by acid acetone, the hæmin precipitated by evaporating the acetone, and recrystallised from propionic acid and HCl in order to remove admixed biliverdin crystals. About nine milligrams of a pure hæmin were obtained from the catalase prepared from fifty pounds of horse liver. The spectroscopic properties and the enzymatic activities of the various fractions were determined throughout.

The hæmin, when acted upon by hydriodic acid and glacial acetic acid, yielded a porphyrin the spectrum of which was identical with that of a sample of pure mesoporphyrin IX kindly given to me by Prof. Otto Warburg. The dimethyl ester obtained by treatment with HCl in methyl alcohol shows the same spectrum as does mesoporphyrin-IX-dimethyl ester. Final proof of the identity is afforded by the fact that the compound (m.p. 214°, uncorr.), when added to an equal amount of synthetic mesoporphyrin-IX-dimethyl ester (m.p. 212°, uncorr.) caused no depression of the melting point of the latter (mixed melting point 213°, uncorr.). I am indebted to Prof. Hans Fischer for a sample of the synthetic ester.

The conclusion seems, therefore, to be justified that the hæmatin group of catalase is a derivative of ætioporphyrin III and possesses a porphin skeleton with the same arrangement of the side chains as is found in the natural blood pigment, that is, in protohæmatin IX.

It is, perhaps, of interest to note that according to D. Keilin and R. Hill[2] and to K. Zeile and F. Reuter[3], the component *c* of cytochrome is also a derivative of ætioporphyrin III.

The details of this investigation will be published elsewhere.

The high activity of catalase is obviously due to the union of the hæmatin with a special protein[4]. Work on the nature of this protein is being continued.

KURT G. STERN.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
July 23.

[1] K. Zeile and H. Hellstrom, *Z. physiol Chem.*, **192**, 171; 1930. **195**, 39; 1931.
[2] R. Hill and D. Keilin, *Proc. Roy. Soc.*, B, **107**, 286. 1930.
[3] K. Zeile and F. Reuter, *Z. physiol. Chem.* **221**, 101; 1933.
[4] K. G. Stern, *ibid.*, **206**, 86, **212**, 207; 1932. **215**, 35, **217**, 237 **219**, 105; 1933.

Colour of the Positive After-Image of a Colour

IN certain conditions, the colour of the positive after-image of any colour or white is purple. It is best to use only one eye and to have both eyes covered with a black cushion before performing the experiment. The object should then be viewed for the shortest possible time and the black cushion be replaced over the eye. If tried with a spectrum, the whole of the after-image becomes purple.

If on a piece of white cardboard eighteen inches square a series of small squares of red and blue cardboard, each about three quarters of an inch square, be pasted to cover a surface of about nine inches square, and the whole is placed in sunlight and viewed as previously mentioned at a distance of about three feet, a brilliant positive after-image, red, blue and white, will be seen for a fraction of a second. Then all changes to purple, which becomes brighter and then disappears from without inwards in about eight to twelve seconds without becoming negative; the last thing to be seen is a whirlpool movement in the centre of the field of vision.

With spectral colours projected on a screen in a dark room the positive after-image of all becomes purple and disappears without changing to negative when viewed for the shortest possible time. When the eye is moved, the after-image spreads out, a portion of the retina not previously stimulated being affected.

These facts suggest very strongly that the photochemical stimulus in vision is liquid and movable in the retina.

F. W. EDRIDGE-GREEN.

Board of Trade,
S.W.1.
July 18.

Dental Caries in Prehistoric South Africans

THE Matjies River Shelter[1] has yielded a very large number of skulls with hundreds of teeth. The deposit commences with a form of the Mossel Bay culture (which may be called Early Mossel Bay) which, in natural superficial strata of the neighbourhood, and in a shelter about eight miles away at Plettenberg Bay, follows immediately on the last phase of the Stellenbosch culture. This phase of the Stellenbosch can be found from Plettenberg Bay to Mossel Bay in a hard red sand lying immediately below the surface layer of black sand, and may therefore be accepted as the end of the Pleistocene; the whole of the deposits of the Matjies River Shelter must therefore be taken to be Holocene.

My collection contains: teeth of one burial from

the late Stellenbosch of Plettenberg; teeth of two adult and one baby burials from the Early-Mossel Bay of Matjies River Shelter; teeth from one burial of the same layer, Plettenberg Bay; teeth from about fifteen burials, with cremated heads, near the top of the Mossel Bay layer; teeth from more than a dozen adult burials in the Wilton-without-pottery layer. *In not one of this large collection of teeth is there the slightest sign of dental caries.*

After this the deposit changes completely; it now consists almost wholly of shells (largely *Mytilus*) instead of ashes; and, from now onwards, caries is very common.

The indication from this area therefore bears out the experience of European anthropologists—that caries is a comparatively modern disease and that no skull showing this condition can be regarded as ancient. Will anthropologists, in view of these facts, revise their views on certain South African finds—I may be allowed to mention particularly the Broken Hill and the Springbok Flats skulls?

T. F. DREYER.

Department of Zoology,
Grey University College,
Bloemfontein. July 28.

[1] Keith and Dreyer, *Roy. Soc. S. Africa*, 21, Pt. II.

Nomenclature of Corpus Luteum Hormone

DURING the past year, the progestational hormone has been isolated from the corpus luteum in pure form and its constitution established. Heretofore, two different names have been used in the literature for this hormone (progestin, luteosterone). For the sake of international uniformity, we agree to use hereafter in the scientific literature only the name *progesterone* for the pure hormone. As is known, the pure hormone exists in two different forms, one melting at 128° (uncorr.) and the other at 121° (uncorr.). The higher melting form (Compound B of Wintersteiner and Allen[1] and Compound C of Slotta, Ruschig and Fels[2]) will be known as α-progesterone, and the lower melting form (Compound C of Wintersteiner and Allen and Compound D of Slotta, Ruschig and Fels) as β-progesterone. We hope that these names will be generally accepted in the scientific literature.

W. M. ALLEN.
Breslau. A. BUTENANDT.
Danzig Langfuhr. G. W. CORNER.
Rochester, N.Y. K. H. SLOTTA.

[1] O. Wintersteiner and W. M. Allen, *Biol. Chem.*, 107, 321; 1934.
[2] K. H. Slotta, H. Ruschig und E. Fels, *Berichte der deutsch. chem. Gesell.*, 67, 1270; 1934.

Points from Foregoing Letters

In reply to Mr. Buchanan-Wollaston's criticism of British statistical methods, Prof. Karl Pearson enumerates some of the uses of the P, χ^2 test, which was devised to find whether a given curve used in graduating observations was a good 'fit'.

When blood from two individuals is mixed, clumping of the red corpuscles may occur, a fact of great importance in blood transfusion. Human beings have been classified into four groups *A*, *B*, *AB*, and *O*, according to their behaviour when mixed. Dr. J. F. Edwards and Dr. I. M. H. Etherington propose a new theory of blood group inheritance, depending on two linked pairs of Mendelian factors, the hypothesis of 'crossing-over' being discarded.

Dr. J. Davidson gives a chart showing the rainfall-distribution ratio in South Australia in relation to the recent outbreak of the migrating grasshopper, *Chortoicetes terminifera*, showing the necessary soil moisture needed for the development of eggs of that insect.

Further investigations to determine the steps by which the hemicellulose constituents of the wood of the oak are formed from starch are reported by W. G. Campbell.

X-ray investigations show that the electrolytically deposited 'explosive antimony', so-called because it crystallises more or less explosively when scratched or heated, is identical with the amorphous films of antimony produced by distillation in a high vacuum. Dr. J. A. Prins suggests that they represent a supercooled liquid state.

As a step towards the spectroscopic analysis of amino-acids, Norman Wright and W. C. Lee have determined the Raman spectra of the light scattered by solutions of glycine, alanine, tyrosine and cystine.

Dr. J. Thomson discusses the mechanism of the initiation of the high-frequency glow discharge in hydrogen. From the results of his experiments, he concludes that there is space-charge present before the discharge begins and that this produces a non-uniform electric field. The experiments are consistent with a simple theory of ionisation by electronic impact. The ionisation potential of the gas may, in certain circumstances, be deduced from the results.

The observation is made by Dr. C. L. Wilson that as the boiling point of hexadeuterobenzene is lower than that of ordinary benzene, benzene behaves in a manner analogous to hydrogen fluoride, hydrogen iodide and acetic acid.

Dr. Dingle admitted that Dr. Sterne had obtained a unique solution of an apparently inconsistent problem of Dr. Dingle's, in inverse probability; but contended that Dr. Sterne's combination of the data had nothing to do with probability. Dr. Sterne disagrees with this contention, claiming that he uses "probability" only in a simple, usual and significant meaning of the word. Dr. Dingle still holds to his position, which he promises to maintain in a forthcoming article.

The non-protein radical of the enzyme catalase (found in liver and in most living tissues) has been isolated by Dr. Kurt G. Stern, who shows that it is derived from ætioporphyrin III; this is also the case with the component *c* of cytochrome, a cell-pigment, originally found in muscle, which plays an important part in the utilisation of oxygen by living tissues.

ERRATUM. The approximate velocity of slow neutrons as indicated by the experiments of Dr. O. R. Frisch and E. T. Sørensen, mentioned in this column in NATURE of August 17, should have been 2,000 metres per second instead of 200.

Research Items

Archæological Research and Peat Deposits in East Anglia

In the report on the recent excavations at Peacock's Farm, Shippea Hill, Cambridgeshire, on behalf of the Fenland Research Committee, by Mr. J. G. D. Clark, Dr. H. and Mrs. M. E. Godwin and Mr. M. H. Clifford (*Antiquaries J.*, 15, 3), reference is made to the employment of two distinct, but complementary, methods of peat analysis as an aid to the work of the archæologist. Of these the first, pollen analysis, is by now familiar. The second, that of examining all other plant remains in the peat beside pollen, has been carried out at Peacock's Farm by Mr. M. H. Clifford. At present it is regarded as only in an early stage, but promising useful development. It has the great advantage that it is an index of the vegetation actually growing on the site in a way impossible for pollen analysis only. In the present instance, in the lower peat below forty-eight inches, all the wood present consists of alder roots, though the pollen analysis shows that the alder was not present at this level. Pine wood is absent, though pine pollen is present and strikingly dominant. In the black layer of the microlithic horizon the plant remains are unidentifiable, except for alder rootlets and a few fruits of hemp agrimony. At 30 inches, a striking change occurs. Wood is very abundant, and there are leaves and fruits of many trees and bushes. At 32 inches, stem wood of alder occurs for the first time, supplemented at 28 inches by stem wood of ash and hazel, at 14 inches by *Rhamnus catharticus* and at 4–6 inches by elm-wood. To these must be added fruits of *Rhamnus catharticus*, dogwood, hazel, raspberry and leaves of oak. This assemblage suggests dense bush and tree growth corresponding to the later stages of 'carr' development in present-day vegetation. From 16 inches to the top of the upper peat there are signs of a return to aquatic conditions, first in the fruits of hemp agrimony and prickly sedge, and afterwards in the rhizomes of reed-mace. There is no evidence of a break in the peat formation due to land uplift or other cause.

Conventionalisation of Design in the Solomon Islands

The simplification and modification, including elaboration in geometric form, of a naturalistic design in the Solomon Islands has been analysed by Capt. T. A. Joyce (*Man*, 108, July) in relation to a peculiar element, which constitutes a constant feature in the turtleshell network of head ornaments. These are worn as forehead ornaments by the people, and consist of a white shell disc overlaid with a 'fretwork' of turtleshell. The delicate fretted patterns bear witness to a remarkable degree of technical skill on the part of a people who had no sharper tool than a shark's tooth. Since the ornaments are circular, the design is radial, and an almost consistent element is a series of spokes, with what may be termed an 'elbow' in the centre of each, the cutting of which must have been a matter of considerable difficulty. It seems likely, therefore, that this feature must have a definite meaning. A clue is afforded by the hollow wooden figures of a bonito fish in which the skull and jawbones of a dead man are enclosed after the great funeral feast has been held. In an example of such a bonito fish now in the British Museum, the back fin of the bonito is its most prominent figure; and the bonito itself is important in Melanesia as a clan-badge. The analysis of the development of the bonito fin can be followed further in the design of a bamboo lime box, also in the British Museum, in which the fish appear reduced to their lowest dimensions; but in all of them there is a highly developed back fin. In these the design is a white fish on a shaded ground; but if the design is reversed to become a shaded design on a white ground, we get the *motif* provided by the radial bars with elbows of the head ornaments. The design on the lime box, therefore, appears to explain that of the head ornaments and to afford another example of the tendency of life forms, simplified and repeated, to become geometrical.

Evolution of the Skull in Horses

The evolution of the skull in the Equidae is the subject of two papers by Dr. R. Cumming Robb (*J. Genetics*, vol. 31, No. 1). By measurements of the skulls of various fossil and living horses, he shows that increase in size from the Eocene *Hyracotherium*, weighing perhaps 20 lb., to the modern Percheron weighing more than 2,300 lb., is accompanied by progressive increase in the pre-ocular length. In titanothere evolution, on the contrary, the preponderance of increase has been in the post-ocular region. This continuous evolution in the shape of the horse skull is a concomitant of one hundred-fold increase in the weight of the animal. If the animal is as small as *Hyracotherium*, the facial index (face length/cranium length) is about 0·8. *Merychippus* and a Shetland pony are of larger but similar size, and have a facial index about 1·5. The law of relative growth will thus account for continuous change in the proportions of the skull, but size mutations may be required to explain the progressive increase in the size of the animal. By measurements of fœtal and post-natal stages in the development of the horse, Dr. Robb shows the same progressive preponderance of the face, with the same linear relationship between muzzle length and skull length. The 'orthogenetic' trend in the evolution of the skull is therefore regarded as a direct result of the increasing size of the animal. Whether this evolutionary increase in size, which is characteristic of so many animal groups, has been aided by natural selection, and whether it has been determined by mutations in size genes, remains undetermined.

The Gorgonid Family, Plexauridæ

In a series of three recent publications, Dr. G. Stiasny has made notable contributions to our knowledge of the Gorgonaceæ. The major of these (*Siboga*-Expeditie, Monographie XIII*b*[7]. Leyden: E. J. Brill, 1935) is a revision of the Plexauridæ based not only on the *Siboga* material, Nutting's original account of the *Siboga* Plexauridæ being insufficient, but also on other material in the possession of the Rijksmuseum van Natuurlijke Historie at Leyden, including two collections made by Prof. H. Boschma at the Tortugas and Bermuda in 1925. Seven new

species and two new varieties are described, while one species receives a new name. There are many new records of distribution of both Indo-Pacific and Atlantic species. Dr. Stiasny, following Prof. S. Hickson in this, deplores the lack of experimental data on the effect of environment on the form of Gorgonids. It is indeed more than time that systematists were not only able but also actually encouraged to study their material, where possible, in the living condition. This necessity is borne out by the second of these communications (*Zool. Anz.*, 110, 179–190; 1935) in which Dr. Stiasny redescribes *Briareum arbestinum*, Pall., the most abundant, and among the most thoroughly studied, of all West Indian Gorgonids. He was able to do this owing to the beautiful preservation of material collected by Prof. Boschma at the Tortugas. The polyps are much larger than previously described and the canal system different. The third paper (*Zool. Anz.*, 109, 236–245; 1935) contains a short summary of the diagnostic features of the known species of the family Plexauridæ.

Nerve Plexuses in *Amphioxus*

DR. J. BOEKE describes (*Quart. J. Micr. Sci.*, 77, Pt. IV; 1935) a nerve plexus on the wall of the liver and adjoining parts of the intestine of *Amphioxus*, with numerous stellate ganglion cells, which may be compared with the plexus of Auerbach of the higher vertebrates. A layer of smooth muscle cells is present with which the processes of the ganglion cells and the nerve fibres of the plexus are in connexion. Covering this layer of smooth muscle cells is a thin layer of connective tissue in which is found a more delicate nervous plexus, analogous to the plexus of Meissner, connected with the first plexus. The nature of the synaptic connexions of the dendrites of the ganglion cells with the nerve fibres of the plexus is discussed. The author is of opinion that there is a true syncytial synaptic connexion; he figures the synapses between dendrites of the ganglion cells and the nerve fibres, and states that there appears to be a real continuity of substance and especially of the neurofibrillar substance. He is totally against the presence at the synaptic junction of a dead intermediate substance of a sticky nature, as is maintained by some neuronists. The enteric plexus is connected by means of the visceral nerves and the dorsal roots with the central nervous system.

New Pinnotherid Crabs

NEW species of the genus *Pinnixa* are described by T. Sakai from Japan and by Steve A. Glassell from the Gulf of California (Science Reports, Tokyo Bunrika Daigaku, Section B, No. 29, Dec. 1934; and *Trans. San Diego Soc. Nat. Hist.*, 8, No. 5, March 1935). The genus consists of 34 species, three of which are fossil, and the species are mostly commensals of worm tubes and are found abundantly on the Atlantic and Pacific coasts of America. Only two have previously been reported from Japan, *P. tumida*, a commensal in the cloaca of *Caudina chilensis*, and *P. penultipedalis*. A third species formerly thought to be *P. occidentalis* is now found to be new, and the author proposes for it the name *P. rathbuni*. He now adds two new species, *P. balanoglossana*, living as a commensal in *Balanoglossus misakiensis*, and *P. haematosticta*, which was collected among dead shells. A key to all these species is given and a description of the new forms. The preliminary descriptions of *P. abboti*, *P. fusca* and *P. felipensis* by Mr. Glassell do not mention any hosts. Fuller descriptions and figures will be published in his forthcoming partial revision of the genus.

Propagation of the Hyacinth

THE *Gardeners' Chronicle* of August 3 contains an interesting article on "British-Grown Hyacinths" by Mr. D. E. Horton. Various aspects of the British trade in bulbs are reviewed briefly, but a large part of the paper is devoted to a description of methods of propagation of the hyacinth. The older method was to make three V-shaped cuts across the root-plate of the bulb, then place it in sand to callus, store it at a warm temperature with suitable humidity, when bulbils would appear at the bases of the scales. A newer method is to scoop out the root-plate with a special knife, and to follow with similar storage conditions. Scooping gives an average of 60–80 bulbils per plant, whilst cross-cutting usually yields only about 20. Moreover, the scoop-formed bulbils make their own roots, whilst cross-cutting produces roots from the mother bulb. Commercial practice suggests, however, that it is best to scoop strong varieties and to cross-cut slower propagators.

Longevity of Fungi

AN interesting paper by Ö. Winge and Aase Hjort, describing experiments on some ancient cultures of fungi, has recently appeared (*C. R. Trav. Lab. Carlsberg, Série Physiologique*, 21, No. 2, pp. 51-58, 1935, "On some Saccharomycetes and other Fungi still alive in the Pure Cultures of Emil Chr. Hansen and Alb. Klöcker"). Winge used cultures 16–17 years old, whilst Hjort, continuing the same investigation, had cultures 31 years old. The Carlsberg Laboratory possessed the original pure cultures, and these have now been tested for vitality by the authors of the paper under review. The oldest living cultures, of a species of *Zygosaccharomyces*, date from 1886—a span of forty-seven years, whilst *Saccharomyces Pastorianus* and *S. validus* had retained vitality for forty-five years in 1934. Solutions of 10 per cent saccharose or beer wort were the culture media employed, whilst Pasteur flasks reduced evaporation to a minimum.

Sediments in the Atlantic Ocean

IN the first part of "Die Sedimente des Äquatorialen Atlantischen Ozeans" (Wiss. Ergebn. d. Deutschen Atlantischen Exped. auf dem Forschungs- und Vermessungsschiff *Meteor*, 1925–1927, 3, No. 3, Lief. 1. Berlin and Leipzig: Walter de Gruyter and Co.) an account is given by Dr. C. W. Correns of the methods of collecting the bottom samples, which were taken on a series of traverses between 10° S. and 20° N., and of their examination both on board ship and afterwards. Estimates were made of the hydrogen ion concentration, carbonate, organic matter, manganese, titanium, iron and phosphorus, etc., as well as of particle size, and the comparison of the latter in fresh and preserved samples is particularly useful. An account is also given of the use of X-ray analysis for the detection of the mineral constituents. The second part, by Dr. W. Schott, describes the distribution of the pelagic foraminifera in the surface waters and in the bottom samples. In the former, their distribution seems to be conditioned by the temperature and phosphate content. Stratigraphically the cores show three layers,

distinguished by their *Globorotalia menardii* content, and probably deposited respectively before, during and since the last ice-age.

Water Exchange through the Straits of Dover

VARIATIONS in the exchange of water between the English Channel and the North Sea have a profound effect on the development there of young fish and of the planktonic animals on which fish feed. Dr. J. N. Carruthers has now published his second report on "The Flow of Water through the Straits of Dover as gauged by Continuous Current-meter Observations at the Varne Light-Vessel" (Min. of Agric. and Fish., Fish. Invest., Series II, **14**, No. 4; 1935), which contains data for 1928–35. Considerable variations have been found in the average set of the current in different years and at different seasons. A marked loss of easting in the current distinguishes the last four from the first four years of the observations, and this fits well with other records of a change in the nature of the waters bathing the south and east coasts of Great Britain. Interesting relations have emerged between the Dover Straits current on one hand and the current round the north of Scotland and the success or failure of herring, plaice, cod and haddock year classes on the other.

Ray Tracks in Photographic Emulsions

H. J. TAYLOR (*Proc. Roy. Soc.*, June 1) has investigated the tracks of α-particles and protons in photographic emulsions, and A. Jdanoff (*J. Phys.*, June) has also worked on this problem. The tracks consist of developable grains, spaced a few microns apart, and are of length corresponding to the range of the particles in the emulsion. Taylor was able to obtain a special emulsion from Messrs. Ilford which was remarkably free from any background of spurious grains. With these plates, all the grains struck by an α-particle became developable, but only a proportion of those struck by a proton. The density of the grains along the track may be used to distinguish between proton and α-tracks. The plates were used to detect the H-particles knocked forward in neutron-hydrogen collisions, but Mr. Taylor thinks the uncertainties of the method do not allow it to be used for the determination of the distribution in detail of neutron energies. Jdanoff uses emulsions specially made to register H-particles and examines the tracks by a stereoscopic microscope method, which helps him to distinguish tracks from chance agglomerations of particles. He claims to be able to detect collisions and disintegrations, just as in the Wilson chamber.

The Oxide-Coated Cathode

M. BENJAMIN, working in the G.E.C. Research Laboratories, Wembley, has investigated the effect of additions to the nickel cores on the thermionic emission from oxide-coated cathodes (*Phil. Mag.*, July), and has found that some metallic additions can profoundly affect the emission. The proportion of added metal was of the order 0·5 per cent. Titanium was found to increase the emission, manganese and iron reduce it, while magnesium produces a temporary increase. It is suggested that the increase is brought about by the reduction of the barium oxide coating by the metal of the core, giving an increased concentration of active barium metal in the coating. This view is supported by the high emission obtained from a filament coated on a case containing the very potent reducer aluminium. During the course of the measurements, it was also found that the oxide-coated filaments fail to show saturation emission at very low temperatures, and this phenomenon is correlated with the change from electronic to electrolytic conduction through the coating as the temperature is lowered. In filaments containing aluminium or titanium, the higher barium concentration results in the electronic conductivity persisting to lower temperatures, and these filaments show saturation at lower temperatures than a pure nickel filament.

β-Glucosidase of Sorghum

ALTHOUGH Emil Fischer regarded α- and β-glucosidases as two distinct enzymes, and this view is supported by a number of recent observations, evidence may be found in the literature which suggests the possible identity of the two enzymes. Of interest in this connexion are the results of experiments on the β-glucosidase of *Sorghum saccharatum*, carried out by C. Antoniani (*Rend. R. Ist. Lombardo Sci. e Lett.*, **68**, parts 6–9). The β-glucosidase examined was obtained either by macerating the ground, germinated sorghum seeds with water in presence of toluene, or by extraction with ammonia solution, followed by purification with acetic acid and alcohol. The velocity of hydrolysis of cellobiose by the enzyme is at first greater than that of salicin, but after 15 per cent of the substrate has been hydrolysed, the position is reversed. The action on salicin is somewhat retarded when glucose, but not when galactose, is added. It appears, from the results obtained, that the sorghum seeds contain an emulsin devoid of β-galactosidase.

Greenwich Catalogue of Stars

THE "Second Greenwich Catalogue of Stars for 1925.0" has been published by H.M. Stationery Office. Part I contains the Right Ascensions and Declinations of 2,111 fundamental stars, observed during the years 1922 to 1930, reduced to the equinox of 1925.0, and Part II contains similar data for 10,584 stars in the zone + 32° to + 64° observed in the same interval. In both cases, Newcomb's precession and Boss's proper motions have been used in effecting the reduction to the adopted equinox (that of 1925.0). The Right Ascensions adopted for the clock stars are those of the Greenwich observations of 1915–1921. A correction to Newcomb's equinox, namely, $-0{\cdot}050^s$, has been adopted in forming the catalogue. Every catalogue star has been observed at least five times in the period 1922–1930. The observations have been made with Airy's transit circle, which itself dates from 1850, and is responsible for the earlier Greenwich catalogues which have been incorporated in the data for proper motion. Although the telescope is the same, the modern observations are much more accurate on account of the application of the impersonal micrometer. In computing the proper motions, a modern place has been found for each star by combining the two most recent catalogues of Greenwich (including the present volume), the Cape, and Pulkova. The star's position for 1875.0 is worked out from the information available in eighteen catalogues, including earlier Greenwich catalogues, made about that time. The probable error of a proper motion varies from $0{\cdot}001''$ to $0{\cdot}010''$ according to the number of observations that have been made at one observatory or another.

Chemical Industry in the United States

PERHAPS the most remarkable thing about the meeting of the American Chemical Society held in April last in New York, and widely heralded as the "Official Tercentenary" of American chemical industry, was the presence of more than 25 per cent of the very large membership, some 17,000, of that Society. No body in Great Britain can count on such loyal support, and it affords a fine illustration of that 'working together' spirit which is carrying the chemical industry forward, so far and so fast, in the United States. Naturally the fare provided was very varied, though by collecting the papers into appropriate groups, it was possible for those with similar interests to forgather.

The social side was well to the fore, a feature being the replacement of elaborate and costly functions by a series of breakfasts, luncheons and dinners, arranged for the alumni of the numerous universities.

The opportunity for propaganda was not missed, including on one hand addresses of a general or topical character delivered by the leaders of the industry, whilst the Press was supplied with a large amount of suitable copy portraying the popular aspect and utility of the work of the chemist. They do these things well in New York under the guidance of the veteran secretary, Mr. Charles L. Parsons, and it is probable that nothing was left undone to make the meeting a gigantic success. It is worthy of comment that all the meetings could be held in the Hotel Pennsylvania, whilst the many delegates could be housed there and in three neighbouring hotels, all connected by underground passages.

Apparently the American chemical leaders are not afraid to criticise the administration. Mr. William B. Bell, president of the American Cyanamide Company, whose theme was "Recovery—by Alchemy or Chemistry", claimed that there is too much Government planning and too much Government waste; the one sound basis of industrial planning being that of purchase and sale, or profit and loss with no political interference or domination. A director of the Du Pont Company claimed that they are on the way to establish an American synthetic rubber industry, and that this has been made possible by the experience gained in the dye industry, which in particular must be in a position to expand quickly in a national emergency to make a variety of essential organic substances.

Emphasis was also laid on the popular use and significance of vitamins, preparations containing such now having the third largest sale in the drug stores.

As a novelty, it was proclaimed that young cereal grasses cut just prior to jointing have, when dry, a biological value many times that of the common vegetables and that men and women will be eating grass in the near future.

Altogether as wide a range of subjects were discussed as must have been dealt with in that famous conversation between the Walrus and the Carpenter —"and why the sea is boiling hot and whether pigs have wings".

Third International Congress of Soil Science

FIFTY countries were represented among the four hundred delegates who attended the Third International Congress of Soil Science held in Oxford on July 30–August 7. The occasion afforded an unrivalled opportunity for discussing the many aspects presented by every problem in soil science, but differing widely according to the geographical region in which the problem is studied. One of the most urgent needs of the science is to break down the parochial barriers which necessarily limit the views of workers confined to one climatic or physiographic region, and faced with the whole-time task of economically justifying their existence. That parochialism exists was amply evident at the Congress, as also were the difficulties of overcoming it; but it was equally evident that the holding of an international congress is a practicable means of producing some kind of order among the conflicting theories held by the world's most eminent pedologists.

The discussions brought into prominence several new directions in which this young science is developing. In the Soil Physics Section, the main interest centred round problems of soil moisture, and Dr. R. K. Schofield introduced a 'pF' scale which precisely specifies the degree of wetness or dryness of a soil in much the same way that Sørensen's pH scale specifies the degree of acidity or alkalinity. The pF is the (positive) logarithm of the amount by which the free energy of the water in the soil is less than that of water in bulk at the same temperature and external pressure expressed as the height in centimetres of a water column. 1 cm. above a free water table is, therefore, pF0 while the 'oven dry' state is approximately pF7. The use of this scale enables a great mass of hitherto unrelated data to be welded together to make an orderly picture of aspects of soil moisture behaviour which are of special importance in irrigation. Dr. Schofield stressed the necessity of recognising hysteresis in the relationship of pF to moisture content, which he regards as due mainly to microplastic resistance to swelling and shrinking.

In the Chemistry Section much attention was directed, as usual, towards the base-exchange properties of soil colloids, particularly from the mineralogical point of view. The structure of montmorillonite and beidellite, as proposed by Hofman, Endell and Milne, was discussed, and Dr. C. E. Marshall showed that the apparent contradictions between their structure and the chemical formulæ can easily be removed by considering the operation

of certain replacements, aluminium for silicon in beidellites, and magnesium for aluminium in montmorillonites. Prof. C. H. Edelman proposed an alternative explanation for the base-exchange properties of the clays, having special reference to halloysite, which he regards as having marked exchange properties.

The Soil Fertility Section held a noteworthy discussion on the methods of estimating the manurial requirements of soils. Prof. E. A. Mitscherlich presented the first results of a great co-operative investigation, in which already 120 soils from different parts of the world have been studied, using more than thirty different methods. This investigation is a model of what can be attempted by international co-operation. Prof. O. de Vries surprised his hearers with an account of the number, running into tens of thousands, and the scope of the field experiments which have been made in the Dutch East Indies. Prof. R. A. Fisher followed this practical account by demonstrating the principles upon which the design of field experiments must be based if their results are to be of any real value. He made clear what is often overlooked, that accuracy alone is not enough, unless the *degree* of accuracy is also known. The very large number of papers dealing with the practical side of soil science which were presented to the Soil Fertility Section emphasised the dominating influence exerted on the development of soil science by modern economic conditions.

This was also apparent in the Soil Classification and Genesis Section. Hitherto the chief object of this section has been to establish an objective basis for soil taxonomy, but the principal matter discussed at Oxford was land rather than soil classification. An excellent series of papers described the methods adopted, with special reference to land settlement plans, in the United States, Canada, Germany and Hungary. Aims and methods differ widely in different countries, and are influenced by modern political trends towards national agricultural planning. The results can scarcely be regarded as objective, but they afford an illustration of the way in which an adolescent science may become involved with a transient political economy. That soil science has become a junior and sometimes fortunately forgotten servant of politics is recognised by research workers striving in many countries to make bricks without straw—to produce the practical results demanded of them with insufficient knowledge of the fundamental nature of the soil. Spectacular successes are still occasionally obtained (though none was described at the Congress) by applying the principles of pure chemistry, physics and biology to soil problems, but the field for such successes is narrowing rapidly, and it seems as if the next real step forward in either pure or applied soil science must be awaited until conditions allow research workers to reason out their problems from the beginning instead of from the end. The general impression left by the Congress was that practice has outstepped theory, and that there is little immediate likelihood that the discrepancy between them will be reduced.

The Radio Exhibition at Olympia

A VISIT to this year's Radio Exhibition at Olympia, organised by the Radio Manufacturers' Association, gave the impression that the broadcast receiver industry is at last beginning to outgrow its somewhat hectic childhood days, and is settling down to a policy of steady progress and development. On this occasion, the show was conspicuous by the almost complete absence of those 'epoch-making inventions', which in the past have involved the coining of new and wonderful names and the development of complicated valves, in an attempt to improve what has so often been termed 'perfect' reception.

The receivers exhibited fall approximately into three fairly distinct classes. The first involves the modest set of three or four stages with straight amplification at radio frequencies, at a price ranging from about five guineas. The second class includes the more elaborate supersonic heterodyne receiver, which combines the advantages of greater sensitivity and selectivity, and which in table and console models can be obtained at prices from ten or eleven guineas upwards. The third involves the incorporation of this receiver into the modern radio-gramophone which, in its more ambitious examples, commands a price ranging from twenty-five to well over a hundred guineas. While all these types of receiver have been available in previous years, the present display showed that the designers and manufacturers are overcoming the difficulties, technical and otherwise, which they have hitherto experienced in the mass-production of a rather complicated piece of radio apparatus. All but the simplest sets now incorporate such features as second-channel suppression, automatic volume control and some device to simplify tuning; while, from the musical listener's point of view, a welcome advance is the incorporation of variable selectivity in the better-class receivers. The general listener is not seriously interested in wavelengths, and to meet this point, it was noticed that there is an increasing tendency on the part of manufacturers to engrave tuning dials with the names of broadcasting stations. While also some firms have made a commendable effort to provide enlarged and improved scales, the indications of which can be read at a glance, in some cases a reminder would appear to be justified to the effect that the ordinary listener is not usually equipped with a pocket magnifying glass. Such a reminder is becoming increasingly necessary now that several receivers are provided with one or two short-wave ranges, in addition to the medium and long-wave ranges. This provision is a welcome addition to this year's sets, and indicates an increased tendency to listen to programmes emanating from stations outside the continent of Europe.

A feature of the exhibition, which is perhaps somewhat significant, was the almost entire absence of any reference to television. One or two firms showed components specially designed for use on ultra-short waves in anticipation of experimenters' requirements, especially when a television service is commenced on

wave-lengths less than ten metres. On the whole, however, it was evident that the industry desires to remove from the minds of the public any tendency to delay the purchase of a new receiver on account of the inauguration of a television service in the future. It is unlikely, of course, that this service will in any way affect the use made of the ordinary set for the reception of sound programmes.

Another noteworthy and very recent development, shown for the first time at a radio exhibition, was a series of midget valves, about two inches or less in length and half-an-inch in diameter. These valves have now been placed on the market and are supplied in patterns of the triode, screen-grid and pentode types, with characteristics comparable with those of ordinary commercial valves. They are of very robust construction and are supplied with neat bases of either bakelite or steatite, the latter being specially suitable for the application of the valves to ultra-short wave working. Valve-holders are also available in either material. The production of these valves has given an impetus to the development of midget receivers, several types of which were displayed at the exhibition. One case is literally a pocket receiver, its dimensions being 6 in. × 4½ in. × 1½ in., and its weight 2 lb., complete with all batteries and frame aerial. This set is used with a single telephone receiver and is claimed to have a normal receiving range of 50–100 miles on the medium wave broadcasting band. It is known that such receivers have been in use by police forces for some time; but they have not hitherto been generally available to the public. Another receiver, employing four midget valves, weighs 9 lb., and its dimensions are about 9 in. square by 5 in. deep. This contains its own frame aerial, batteries and loud speaker, and since in size and appearance it is much like a box camera, it offers a new conception of the term 'portable wireless set'.

Readers of NATURE who are interested in obtaining further information on any items mentioned above or other matters covered by the Radio Exhibition will be assisted by reference to the Exhibition numbers of the *Wireless World* or *World Radio* (issues dated August 16 and 23 in each case).

The State of Flowering known as Angiospermy

UNDER this title, Prof. J. McLean Thompson makes a very interesting contribution to current speculations as to the nature of the carpel (Publ. Hartley Bot. Laboratories, No. 12, University Press of Liverpool, 1934). His views are based mainly upon developmental studies and close comparative studies of types within a limited range of affinity. These are sound grounds upon which to base morphological conceptions, and they require careful consideration, even if at first view they run directly counter to many popular conceptions.

The flower is regarded essentially as an axis of limited growth with a potentiality to produce sporogenous tissue. This growth centre earlier was vegetative, and the transition to sporogenous growth activity is indicated by the transitional region of bracteoles, sepals, etc.; similarly, the zone between two types of heterosporous tissue may be marked by carpellary structures bearing anthers; the essential fact is the tendency to bear sporogenous tissue upon an axial emergence which may take various forms.

A series of monocotyledonous forms with inferior ovaries is studied, with the result that no ground is found in their development for the view that the placentæ should be regarded as the ingrowths of the walls of sunken carpels. Rather there is extensive toral growth that gives an ovary wall; on the inner rim of this are outgrowths, of which nutrition is often defective and which may be interchangeably style or staminode.

In the same way, a study of the superior apocarpous gynæcium in the Ranunculaceæ suggests that the follicle is to be regarded as a toral upgrowth, after apical growth of the axis has ceased, which links together several associated primordia of a complex spiral phyllotaxis, primordia which lower on the axis would bear anthers and now are associated in the production of ovules. Similarly, the carpels of the *Ranunculus* flowers are the upper members of orthostichies which lower on the axis are represented by stamens; these upper members are essentially sporogenous, and in their central position bear ovules.

Educational Topics and Events

DR. NICHOLAS MURRAY BUTLER'S report for 1934 on the Carnegie Endowment for International Peace, Division of Intercourse and Education, is a very interesting record of extensive and carefully organised propaganda in the United States of America, in Europe, in Latin America and in the Orient. In the United States, the Endowment's doctrine of international co-operation as the normal method of conducting world affairs in lieu of the rule of force finds ready acceptance in universities and in educational circles generally: the difficulty is how to reach the people whose opinions have decisive weight when it comes to divisions in Congress and Senate. The 36 Senators who on January 29, 1935, voted against the ratification of the World Court Protocol, so that the affirmative majority fell short of the requisite two-thirds, prevented their Government, the report points out, from co-operating effectively in an important application of this doctrine—a heavy responsibility. International relations clubs, which are groups of students meeting regularly with a faculty adviser, increased during the year in universities and colleges on the United States by 53, making a total of 523. In addition, the movement extended to high schools, in which more than a hundred clubs have been established. The Endowment co-operates by presenting books and other material with the object of giving that background of facts which will enable students to read more understandingly the international news and exert a wider influence after leaving school and college. Outside the United States, 130 such clubs have been formed during the past four years in 29 countries, among which the only European countries are Bulgaria, Great Britain and Greece. Among publications for which the Endowment is responsible are "International Conciliation" and "L'esprit international". The work of the Division in Europe is conducted from Paris (173 Boulevard St. Germain) by a Directeur-Adjoint with the help of a committee representing Austria, Belgium, France (3), Germany (2), Great Britain (2), Greece, Hungary, Italy (2), Spain and Switzerland.

SCIENCE versus superstition in China has not the news-value of the wars of the war-lords, but it is a conflict of which the issues are probably of far greater moment. A letter from Peiping Union Medical College published in *School and Society* of March 30 gives some idea of the strength of the defensive positions which bar the progress of Western science in that country. Every year a considerable number of natives of China graduate at universities in Europe and America and return to their native land with the object of entering upon the practice of medicine or engineering or whatever other profession they have been qualifying themselves for. Provided they are content to settle in one of the coastal cities, they have every prospect of establishing themselves in lucrative and honourable positions, in which they will have ample scope for demonstrating the value to the community of their newly acquired Western knowledge and training. But once they venture into the interior of China, they find themselves up against the most baffling obstacles. Their attempts to apply scientific methods are met with distrust, contempt and ridicule; a mass of deeply entrenched vested interests is stirred into activity; they find their plans thwarted by intrigues and their young enthusiasm speedily evaporates. For in the majority of cases, such students get their first effective contact with Western ideology when they are already about sixteen years of age and consequently they suffer, on repatriation, from "a basic lack of confidence in the fundamental truth of that which they have learned abroad". There has been little or no common ground between the culture absorbed in childhood and the new culture, with its radically different modes of expression, picked up in the West. For the moment, the situation is not encouraging for those who have striven to provide a nucleus of foreign-trained Chinese with whose help China could learn to help herself.

Science News a Century Ago

Memorial to Watt at Greenock

THE issue of *The Times* of August 24, 1835, reported: "The Committee appointed to conduct the erection of the Watt monument and public library at Greenock have with the approbation of the Provost and magistrates of Greenock, and the most worshipful the Provincial Grand Master for Renfrewshire resolved that the foundation stone of the monument be laid with masonic honours on Tuesday, 25th inst. The mason lodges, corporate bodies and trades desirous of doing honour to the memory of Watt, in his native town, have determined on a public procession and the necessary arrangements are being made."

Fall of the Dent du Midi

ON August 26, 1835, "A considerable portion of the principal peak of the Dent du Midi, one of the great spurs of Mont Blanc, fell with a tremendous crash into a deep and narrow valley situate about a league to the eastward of St. Maurice, on the road to Martigny. An accident of a similar nature occurred in the year 1818 when no less than 400 houses were washed away. In this recent instance the peak in its fall carried with it a glacier, which, filling up the valley, dammed up the stream which ran through it, until it had acquired sufficient force to drive before it the whole mass of earth and rocks into the bed of the Rhone, the course of which became so completely barred as to dry up all below it, and convert the upper part of its rugged and rocky course into a sort of temporary lake. . . . It was not known that any lives had been lost, but the passage across the Alps by the great Simplon road was for a time cut off. An attempt was immediately begun to reopen the communication by a temporary road, which was to describe a considerable circuit." ("Annual Register".)

The Yaguarundi

"THIS beautiful species of *felina*, known only to naturalists by the description of it by Azara in his travels in South America," it is recorded in *The Times* of August 27, 1835, "has been brought for the first time to this country, and arrived last week in the Louisa Bailey from Guiana. It belonged to Mrs. Alboua, and has been presented by her to the Surrey Zoological Gardens. Its general form and character strongly resemble those of the puma, but having the limbs more slender in proportion to its size, the head more pointed, the strength of the jaws and teeth proportionately less, and the tail one-third of the animal's own length. . . . It is an inhabitant of the deep recesses of the forests of Paraguay and Guiana, climbing trees readily, and preying upon monkeys and small birds, but will boldly attack large quadrupeds. Its possession will form a valuable addition to our knowledge of the history of this genus of animal."

Halley's Comet seen in England

HALLEY'S COMET was first seen in England by Sir James South at Kensington, and then by the Rev. T. J. Hussey at Hayes Rectory. On August 31, 1835, *The Times* contained the following note: "Halley's Comet. Royal Observatory, Greenwich, Aug. 28. At 14 h. 7 m. 35.6 s. mean time, the right ascension of the comet was observed by the five feet equatorial to be 5 h. 47 m. 42.1 s. and declination 24 deg. 25 m. 33 s. north. It appeared very faint."

The Steamships of Great Britain

THE *Mechanics' Magazine* of August 29, 1835, gave some interesting particulars of the number and size of the steam vessels in Great Britain, and the ports to which they belonged. The figures had been taken from a return recently made to Parliament. The total number of steam vessels registered in Great Britain was 397 with a total tonnage of 36,849 tons. There were 84 steam vessels not registered, and 46 under construction. Of the ports, London was at the head of the list with 98 vessels of 11,785 tons and Glasgow second with 56 vessels of 5,298 tons.

The six largest vessels at the time were: *Monarch* of London, 587 tons; *City of Aberdeen*, 384 tons; *Dundee* of Dundee, 399 tons; *City of Hamburgh*, 380 tons; *Perth* of Dundee, 399 tons; *John Bull* of London, 398 tons. The registered tonnage, it was explained, was only about one third of the tonnage by admeasurement; and it was estimated that the aggregate tonnage of the steam vessels of Great Britain was about 100,000 tons. The sailing ship tonnage of Great Britain at this time was probably about 3,000,000 tons.

Societies and Academies

PARIS

Academy of Sciences, July 1 (*C.R.*, 201, 1–104). LOUIS BLARINGHEM: The duplication of the flowers of the wallflower (*Cheiranthus Cheiri*). JEAN REY: The energy yield of thermo-compressors. Definitions and values. The efficiency of a thermo-compressor can be defined in six ways, all rational. The values differ, and if the compressor is bought under guarantee, the exact definition of field must be specified. H. GRUYELLE and CHARLES POISSON: The magnetic anomalies of the crystalline massif of Madagascar. The magnetic survey by E. Colin between 1901 and 1906 gave magnetic charts of great complexity due to the presence of anomalies. These are now shown to be very local and are mainly due to the presence of magnetite in certain of the underlying rocks. ANDRÉ CARREL and CHARLES A. LINDBERG: The culture of entire thyroid glands. The thyroid gland, with its epithelial cells, its conjunctive tissue, arteries and veins, continues to live for at least 20–30 days under the conditions described in these experiments. Its structure, the structure and activity of its follicles vary rapidly with the chemical composition and the physical and physico-chemical conditions of the liquid circulating in the vessels. WALTER S. ADAMS was elected *Correspondant* for the Section of Astronomy in succession to the late F. Gonnessiat. PIERRE DAURE: Remarks on the validity of statistical conceptions applied to social phenomena. GARRETT BIRKHOFF: Discrete spaces. RAYMOND JACQUES: Certain systems of partial differential equations. ALFRED ROSENBLATT: The Green's function of a limited domain of Euclidian space of three dimensions. M. KREIN: 'Charged' integral equations. W. BŘEČKA: Multiply monotonic polynomials which deviate least from zero. FRÉDÉRIC ROGER: Some metric applications of the idea of the bilateral contingent. LARS AHLFORS: The type of a Riemann surface. ALBERT TOUSSAINT and MIROSLAV NÉNADOVITCH: Contribution to the study of certain rigid biplane cells of finite span. MAURICE DENIS: Contribution to the experimental study of sustaining wings at large incidences. E. M. ANTONIADI: Recent observations of the planet Mars with the 83 cm. telescope of Meudon observatory. The appearance of Mars shows no great difference from that shown in 1933. Details of the observations are given. FRÉDÉRIC MARGUET: The curve of equal azimuth and its use in navigation. GEORGES ALLARD: Statistical mechanics and the equilibrium of radiation and of matter. ANDRÉ LÉAUTÉ: The measurement of the surface tension of viscous substances such as tars and bitumens. Studies of the capillary tube method, paying special attention to the time necessary to attain equilibrium, one bitumen requiring 360 hours. Discussion of the causes of the large divergences between the results obtained by this and by other methods. CLAUDE CHARMETANT: The electrolysis of nickel and cobalt chlorides in solutions of mixtures of water and ethyl alcohol. HUBERT FORESTIER: Magnetisation at a high temperature of ferromagnetic powders. Powders (precipitated ferrites, oligist) heated to the temperature of the Curie point and cooled in a magnetic field showed residual magnetism. This is now shown to depend on three fundamental factors, strength of the field, fineness of the grains, and the crystalline structure. NICOLAS SZULC: Study of the structure of the electric arc. From the results of the experiments described it is concluded that the electric arc is divided into two parts: a conducting part where the electrical energy is partly used in producing dissociation of exothermic compounds and the formation of endothermic compounds, and a slightly conducting part where exothermic compounds are formed. HUA-CHIH CHENG and JEAN LECOMTE: The modes of vibration of the 1,2,dihalogen derivatives of ethane. The results tabulated are based on Raman spectra and maxima of infra-red absorption. MICHEL DUFFIEUX: The phosphorescence of nitrogen peroxide. The intensity of the bands of the second positive group of N_2. STÉPHAN PROCOPIU: The depolarisation of light by colloidal solutions, by crystalline precipitates and by solid deposits on glass. MAURICE LUCAS: The variation of the length of cement as a function of the hygrometric state of the air. The experimental results are given graphically in three curves, showing the change of length as a function of the weight of water absorbed, and as a function of the hygrometric state of the air, and the change of weight as a function of the hygrometric state of the air. JEAN MOLNAR: The physicochemical properties of picric acid in the *p*H scale. The experimental results can be explained on the hypothesis that picric acid passes through seven molecular forms with changing *p*H. PIERRE JOLIBOIS and FRANÇOIS OLMER: A new method of catalysis. Application to ammonia. ANDRÉ MICHEL and ANDRÉ GIRARD: Thermomagnetic analysis as a means of proving the existence of weak solid solutions of the oxides of iron. F. BOURION and E. ROUYER: The cryoscopic determination of the total hydration of the ions of magnesium chloride. JEAN BUREAU: The system calcium nitrite, water. MLLE. MARIE FALINSKI: The increase in the rotatory power of mannite by zirconium salts in aqueous solutions. MARCEL PATRY: The telluric acid group. Nomenclatures. T. KARANTASSIS and L. CAPATOS: The complex iodine compounds of divalent germanium. ORESTE MILLER and LÉON PIAUX: The Raman spectra of *meta*- and *para*-dimethylcyclohexane *cis* and *trans* isomers, and of 1,1,dimethylcyclohexane. CONSTANTIN GHEORGIU and MLLE. LUCIE MANOLESCU. Heteropolar combinations: complex salts of silver and mercury with 2,thio-4-hydroxy-1,2,3,4-tetrahydroquinazoline. CHARLES LAPP: The specific rotatory power of salts of quinine, quinidine, cinchonine and cinchonidine. PAUL BRENANS and PIERRE LARIVAILLE: Iodo-*m*-nitrophenols. EDMOND BOCQUIER: The existence of a group of large fossil cavities of the Monasterian epoch on the coast of Talmondais (Vendée). V. BABET and RAYMOND FURON: The continental post-Hercynian formations of the west of Africa (western Africa and equatorial Africa). MAURICE GENCE: The bases of the Klippes of Etienne-Encauron, to the north of Sainte-Baume. GEORGES DENIZOT: The successive tectonic phases in the neighbourhood of Marseilles. PIERRE URBAIN: The separation of the various constituents of marls. LOUIS DANGEARD: The black Eocene clays of the Londe forest (Lisieux geological sheet) containing algæ belonging to the genus *Botryococcus*. J. LEGENDRE: The maritime mosquito. BORIS EPHRUSSI and G. W. BEADLE: The transplantation of the imago discs in *Drosophila*. LOUIS COTONI and JACQUES POCHON: The application to antistreptococcic sera of a new method of titration by the neutralisation of the antibodies *in vitro*. RADU CODREANU: Malignant neoplasis in the hæmocœle of Ephemers under the action of *Symbiocladius rhithrogenae*, a Chironomid ectoparasite.

CAPE TOWN

Royal Society of South Africa, June 19. M. RINDL and M. L. SAPIRO: The alkaloids of *Strychnos Henningsii* (3). Isolation of a second crystalline alkaloid. On the basis of a large number of analyses of the crystalline alkaloid isolated both by the authors and by the firm of E. Merck, of Darmstadt, Germany, the formula $C_{22}H_{25}N_2O_4(OCH_3)$ is ascribed to this compound. This formula differs from the one previously suggested. The alkaloid is probably phenolic. The crude alkaloid is accompanied by very small quantities of a second alkaloid, which can be removed by continuous percolation with ether and purified by high vacuum sublimation. Analyses suggest a formula differing from that of the first crystalline alkaloid by an increment of CH_2. The likelihood is that the two alkaloids are the monomethoxy and dimethoxy derivatives of the same mother substance. There is also evidence of the presence of a third crystalline alkaloid. J. L. B. SMITH: The genus *Tripterodon*, Playfair. The fish *Triperodon*, the anatomy of which and taxonomic features have hitherto been inadequately studied, has been investigated. Morphologically it appears that it should be included in the family *Platacidae*. J. BURTT DAVY: *Taraxacum magellanicum*, Comm., in South Africa. S. BIESHEUVEL: The nature of temperament. The behaviour qualities grouped together under the heading of temperament have been reduced to three distinct units, for each of which a psychological explanation has been found. The relationship of these fundamental factors to environmental influences and organic processes has been tentatively determined. R. S. ADAMSON: Note on the stem structure of *Boscia rehmanniana*, Pest. The old stems have anomalous secondary thickening with successive extrafascicular cambia. These arise as separate portions and develop tissues both centrifugally and centripetally. The centrifugal growth is much greater than the centripetal.

GENEVA

Society of Physics and Natural History, June 20. M. GYSIN: The copper minerals of Kinsenda (Belgian Congo) (3). On the presence of a hypogene covelline and a supergene covelline. The author describes two varieties of covelline observed in the copper minerals of Kinsenda. The first variety forms lamellar inclusions in bornite, which start from the (100) cleavages to develop in the octohedral (111) directions; it is of hypogene origin. The second variety, of supergene origin, forms large tufts which spread over outside the grains of chalcopyrite and of white chalcosine, following generally the sphenoidal octohedral directions of the two minerals. TH. HILLER: (1) Contribution to the study of opaque minerals by the methods of impressions. Improvement in the technique of electrolytic attack. The author describes a technique for etching electrolytically and then taking a chemical print of the grains of isolated minerals in the gangue. This method allows opaque conducting minerals, completely refractory to ordinary chemical reagents, to be attacked, and shows their principal elements without destroying the specimens. (2) The determination of some linneites of Northern Rhodesia and Katanga by the method of imprints. The author describes the chemical reactions utilised for identifying cobalt and copper in some linneites with polished surface by the method of imprints. The simultaneous presence of these two elements is a character peculiar to linneite, and this permits its differentiation from a series of optically analogous minerals. P. WENGER, CH. CIMERMANN and MLLE. NYSZEWIANSKA: The microestimation of cadmium by means of oxyquinoline.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*].

Sunday, August 25

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Fish and Whales".*

IMPERIAL BOTANICAL CONFERENCE, August 27–30. To be held in the rooms of the Linnean Society, Burlington House, London, W.1.

August 28. Sir Arthur Hill: Presidential address.

Official Publications Received

Great Britain and Ireland

London Shellac Research Bureau. Technical Paper No. 3: Fundamental Physical Properties of Lac. Part 1: Mechanical Properties. By Dr. Lal C. Verman. Pp. 38. (London: London Shellac Research Bureau.)

Seale-Hayne Agriculture College: Department of Plant Pathology. Eleventh Annual Report for the Year ending September 30th, 1934. (Pamphlet No. 44.) Pp. 59. (Newton Abbot: Seale-Hayne Agricultural College.)

Force and Youth. By Lord Davies. (New Commonwealth Pamphlets, No. 9.) Pp. 10. (London: The New Commonwealth.) 3*d*.

Rothamsted Experimental Station, Harpenden. Report for 1934. Pp. 259. (Harpenden: Rothamsted Experimental Station.) 2*s*. 6*d*.

Other Countries

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 8, No. 3: General Information for the Year 1935–1936. Pp. 164. (Houghton, Mich.: Michigan College of Mining and Technology.)

Proceedings of the United States National Museum. Vol. 83, No. 2977. Parasites of Fishes in Galveston Bay. By Asa C. Chandler. Pp. 123–157+plates 6–12. Vol. 83, No. 2978: On the Reptilia of the Kirtland Formation of New Mexico, with Descriptions of New Species of Fossil Turtles. By Charles W. Gilmore. Pp. 159–188+plates 13–18. (Washington, D.C.: Government Printing Office.)

University of Illinois: Engineering Experiment Station. Bulletin No. 270: Laboratory Tests of Three-Span Reinforced Concrete Arch Bridges with Decks on Slender Piers. By Prof. Wilbur M. Wilson and Ralph W. Kluge. Pp. 134. 1 dollar. Bulletin No. 278: Mechanical—Electrical Stress Studies of Porcelain Insulator Bodies. By Prof. Cullen W. Parmelee and Prof. John O. Kraehenbuehl. Pp. 72. 75 cents. (Urbana, Ill.: University of Illinois.)

Baltic Geodetic Commission. Special Publication No. 4: Remeasuring of the Base Lines of Lolland and Öland in the Year 1933. By Ilmari Bonsdorff. Pp. 36. (Helsinki: Baltic Geodetic Commission.)

Suomen Geodeettisen laitoksen julkaisuja. No. 21: Zwei Ausgleichungen des grossen südfinnischen Dreieckskranzes. Von V. R. Örlander. Pp. 66. (Helsinki. Finnischen Geodatischen Institutes.)

The Journal of the Shanghai Science Institute. Section 3, Vol. 2: Bibliographical Introduction to the Study of Chinese Insects. By Yoshio Ôuchi. (Entomological Report No. 1.) Pp. lii+533. (Shanghai: Kelly and Walsh, Ltd.; Tokyo. Maruzen Co., Ltd.) 5 M. dollars.

Expédition Antarctique Belge. Résultats du voyage de la *Belgica* en 1897–99 sous le commandement de A. de Gerlache de Gomery. Rapports scientifiques. Zoologie—Oligochètes. Par Dr. Léon Cernosvitov. Pp. 11. Zoologie—Pycnogonides. Par Dr. Louis Giltay. Pp. 16. Botanique—Observations sur des Algues. Par E. de Wildeman. Pp. 47. (Bruxelles: Musee Royal d'Histoire Naturelle.)

The Currents in the St. Lawrence Estuary, Ste. Anne des Monts to Father Point, 1932–1933. Pp. 42+3 plates. (Ottawa: Canadian Hydrographic Service.)

Sudan Government. Annual Report of the Gezira Agricultural Research Service for the Year ended 31st December 1934 relating to Experimental Results obtained in the Season 1933–34. Pp. xi+170+14 plates. (Wad Medani: Gezira Agricultural Research Service.)

Department of Agriculture: New South Wales. Science Bulletin, No. 46: Plant Diseases recorded in New South Wales. By Dr. R. J. Noble, H. J. Hynes, F. C. McCleery and W. A. Birmingham. Pp. 47+1 plate. (Sydney: Government Printer.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 122: On the Wall Interference of a Circular Wind Tunnel. By Kwan-ichi Terazawa. Pp. 75–81. 15 sen. No. 123: On the Smokeless Zone around a Heated Platinum Ribbon. By Syûzô Miyake. Pp. 83–106+7 plates. 40 sen. No. 124: Psychologische Untersuchung über den zeitlichen Verlauf der Einflusse des niederen Luftdrucks. Von Yenziro Awadi und Tuneo Toyohara. Pp. 107–123. 35 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON
Telephone Number:
WHITEHALL 8831

No. 3435 SATURDAY, AUGUST 31, 1935 Vol. 136

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Science and Leadership in Industry

THE industrial position of the north-east coast of England has been built up on the four basic industries of coal mining, iron and steel production, shipbuilding and ship-repairing, and marine and general engineering. These four industries are among those most severely hit by the post-War depression. The report on the industrial survey of the area conducted in 1931 for the Board of Trade by Armstrong College, Newcastle-upon-Tyne, stated that the problem facing these industries was one of the scaling-down to meet a diminished demand which is likely to be permanent, but suggested that with enterprise the north-east coast should retain its pre-War proportion of the total output of the whole country.

The report recognised, on the other hand, that there was little prospect of increasing that proportion, but pointed out that this depended on the amount of initiative shown by the industrial leaders in the area. This emphasis on leadership was repeated throughout the report. Development, it insisted, depended largely on the adaptation of existing works to new needs and new conditions; the industrial future of the area depended in the main on its own business leaders. Wherever possible they must call in science to their aid. In agriculture, as in industry, what was needed was the willingness and ability to appreciate new ideas, to adopt new methods and to try out new enterprises.

Memoranda contributed to the report cited examples of recent failures of industry in this area, particularly chemical industry, to meet these needs and to provide a broad and enlightened scientific leadership backed by adequate research. As example, reference was made to the failure of the Newcastle Chamber of Commerce to grasp the opportunities afforded by such developments as the manufacture of acetic acid and acetone, or the rayon industry, the synthesis of methyl alcohol and of liquid fuel from coal, all of which have since reached commercial production outside the area. The opinion was also given that the attitude of the shipbuilding industry towards research was not so favourable as it should be, and doubt was expressed as to whether without attention to research this industry would continue to lead the way. Prof. H. V. A. Briscoe insisted on the necessity for scientific invention and discovery to take the place that mechanical invention formerly held, and asserted that the chief hindrance to development lay in the fact that, in general, the directors and executive officials responsible for the policy and organisation of industry were unable to understand or appreciate scientific matters and methods, whether in technical manufacture or commercial operations. Because they did not really know or understand the basic scientific principles which underlie their operations, business men did not know enough either to seize the good or reject the bad when confronted with possible developments. He urged that business men should depute their task of consideration and decision in *technical* matters to scientific men who are also sound business men, though not necessarily having previous knowledge of the particular business.

The memorandum on science and industry which Prof. G. R. Clemo and Dr. J. T. Dunn have recently submitted to the District Commissioner for Depressed Areas at Newcastle-upon-Tyne, some points from which are described in an article on p. 323 of this issue of NATURE, indicates that unfortunately those warnings have as yet received little attention. The figures quoted in the memorandum relating to the employment of scientific

graduates in local industries indicate a most disappointing situation, even for a time of bad trade and general unemployment. Of 184 honours graduates in chemistry from Armstrong College, only a dozen secured industrial employment locally, although they were employed in large numbers elsewhere. In physics, only one out of thirty-nine honours graduates during the past five years obtained local employment in industry. Even in the applied sciences such as electrical engineering, only 20 per cent at most of the students are to be found holding local posts five years after graduating, in spite of the fact that about 85 per cent of them are attached to a works before entering college.

These figures in themselves are sufficient to suggest that neglect of scientific skill is one of the reasons for the industrial sickness on Tyneside, but other evidence also is quoted to show that the best possible scientific direction of industry is not exercised there to-day. Even if it be admitted that a committee of men of science may overestimate the importance of employing scientific workers, the instances cited of missed opportunities in regard to new developments in coal products as well as the continued absence of a definite centre for shipbuilding research and the neglect of valuable by-products of the fishing industry, show that lack of foresight and not the general absence of jobs is the real reason for the non-employment in the area of graduates in science.

The singularly slight use which Tyneside is making of its fine centre of scientific education in Armstrong College is not due to the recruitment of scientific staff from other universities, for no case of any such appointment was discovered in the inquiry. Moreover, there is evidence of a similar neglect of technical education, and the absence in the district of any chair founded or laboratory built and endowed by industrialists, as are to be found at Manchester or Liverpool, for example, is further significant confirmation of the inadequate recognition of the importance of industrial development.

In contrast with the present position, it must be remembered that the alkali industry of the north-east coast of England was founded and carried on by men who made the best use of the science of their time; for long it was a source of prosperity to the district. The Newcastle Chemical Society was founded in 1868 and was a highly flourishing society when its membership in 1883 became the nucleus of the Newcastle Section of the present Society of Chemical Industry. Moreover, the whole area, with its natural advantages in the situation of coalfields and ironworks, enjoyed its full share of prosperity during the first part of the industrial revolution.

The indictment brought forward in Prof. Clemo and Dr. Dunn's memorandum is thus supported by far too convincing evidence to be lightly dismissed. While no one reason will account for the decline of the area, a great factor has been a narrow outlook which failed to recognise that industry is based on science, and that a policy which drains the profits and leaves insufficient resource for research and development is doomed ultimately to failure. The ease with which success has been gained in the past has induced the leaders of industry on Tyneside to rest too readily upon their laurels.

Lack of foresight as an outcome of prosperity experienced a generation or two ago is not confined to Tyneside. Similar charges have been brought against the textile industry in Lancashire, particularly of the neglect of technical training and the use made of juvenile labour. In his jubilee lecture to the Society of Chemical Industry this year, Mr. C. J. T. Cronshaw showed how the decline of the early dyestuffs industry in Great Britain could be traced to an exactly similar lack of foresight on the part of its leaders, and under modern conditions industry more and more demands this quality of foresight. As successive reports of the Department of Scientific and Industrial Research have emphasised, industry in Great Britain can only meet the fierce competition to which it is now exposed by a determined and persistent effort to apply the results of research and scientific discovery both to the cheapening and improvement of existing products and the development of new ones, as well as to the exploration of the natural resources of the country, combined with close attention to the question of technical training, efficient organisation and management. The nation cannot, in fact, afford to allow industry to be retarded by leaders who have lost the capacity of foresight and leadership, and whether in the depressed areas or elsewhere means must be found of rectifying the position.

So far as defective industrial leadership has contributed to the present position on Tyneside, it is probably not too late for a number of remedial measures to be applied. The various memoranda presented to the District Commissioner indicate several directions in which investigations could profitably be initiated, and the District Commissioner

is unlikely to be without either the power or inclination to effect some of the obvious reforms. The great enterprise of Imperial Chemical Industries, Ltd., at Billingham, which has been carefully exempted from the Committee's argument, provides a stimulating example of what is possible when foresight and vigorous leadership are forthcoming.

On the general body of scientific and technical opinion in the area, however, as well as in the rest of the country, a special responsibility rests. Whatever reforms may be imposed by the District Commissioner from above, it is only as scientific workers complete the task of education initiated by this joint committee representing the local sections of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, that we can expect to see the fullest and most scientific use made of the resources of the area either in materials or in man-power. From their ranks inevitably must be drawn many of the future leaders. For many years they may be called upon to exercise those advisory functions suggested by Prof. Briscoe, and it is only as they insistently support the arguments advanced by Prof. Clemo and Dr. Dunn that we can hope to see the habits and prejudices of years broken down and replaced by more enlightened ones.

The action taken by this Joint Committee provides an example of the ways in which scientific workers can serve the needs not merely of the special areas but also of the whole country, an example fully as inspiring as that already provided in the industrial surveys carried out for the Board of Trade. Through this work their special knowledge no less than their civic zeal should find ample employment. In thus emphasising the practical directions in which developments are possible and the part which science has to play in industrial leadership and development, they will go far towards meeting the first need of these special areas in bringing them hope and creating work.

The Basis of Modern Mathematical Analysis

Inequalities
By G. H. Hardy, J. E. Littlewood and G. Pólya. Pp. xii+314. (Cambridge: At the University Press, 1934.) 16*s*. net.

INEQUALITIES, as opposed to equalities, may be said to form the basis of modern mathematical analysis. The arithmetical definition of a limit is itself based upon the idea of inequality, and in the hands of the school founded by Weierstrass and his successors has removed from analysis the vagueness and mystery which were due to appeal to an indefinitely qualitative idea of continuity. A book on inequalities by three leading mathematical analysts is therefore an event in the realm of mathematical literature, the more so since no book on this subject has been published before.

The book was originally planned to form one of the Cambridge Tracts; but the authors soon found that a larger work would be necessary to fulfil the ideals which they had in view. These ideals demand a complete discussion of the important elementary inequalities by the most elementary methods appropriate to the case and an exhaustive enumeration of the cases where inequality degenerates into equality. Thus Cauchy's inequality

$$(\Sigma ab)^2 < \Sigma a^2 \Sigma b^2,$$

unless (a) and (b) are proportional, is a proposition of finite algebra (in the case of finite sums) and the proof should involve only the methods of that theory. Cauchy's inequality is itself a particular case of Hölder's inequality

$$\Sigma ab < (\Sigma a^k)^{1/k}(\Sigma b^{k'})^{1/k'},$$

where $k > 1$, $k' = k/(k-1)$, unless (a^k), $(b^{k'})$ are proportional. An inequality equivalent to Hölder's is

$$\Sigma a^\alpha b^\beta < (\Sigma a)^\alpha (\Sigma b)^\beta,$$

unless (a) and (b) are proportional, where α, β are positive and $\alpha + \beta = 1$. When α is rational this is also a theorem of finite algebra. When α is irrational a^α is not an algebraic function and a step outside algebra must be taken. If we define a^α as $\exp(\alpha \log a)$ the proof must necessarily involve the theory of the exponential and log arithmetic functions and this should be the only step outside algebra which is taken in the proof. On the other hand, if we define a^α by

$$a^\alpha = \lim a^{\alpha_n},$$

where (α_n) is a set of rational numbers whose limit is α, then the proof should involve an appeal to this limiting property alone. Here, however, another difficulty arises. Assuming the inequality to have been proved for rational α, in the passage

to the limit the sign $<$ becomes $\leqslant$, whereas the sign should still be $<$, so that the proof is incomplete. The difficulty can be turned by putting $\alpha = \gamma + \lambda$, $\beta = \delta + \mu$ where γ and δ are rational. Then, if $\gamma + \delta = \epsilon$, $\lambda + \mu = \nu$,

$$\Sigma a^\alpha b^\beta = \Sigma(a^{\gamma/\epsilon}b^{\delta/\epsilon})^\epsilon(a^{\lambda/\nu}b^{\mu/\nu})^\nu$$
$$\leqslant (\Sigma a^{\gamma/\epsilon}b^{\delta/\epsilon})^\epsilon(\Sigma a^{\lambda/\nu}b^{\mu/\nu})^\nu$$

But $\Sigma a^{\gamma/\epsilon}b^{\delta/\epsilon} < (\Sigma a)^{\gamma/\epsilon}(\Sigma b)^{\delta/\epsilon}$, and a similar inequality with $\leqslant$ for the other sum. The theorem then follows by combination of these results. The same difficulty arises in the passage from a finite inequality to one involving infinite series or integrals. It is therefore important to frame proofs in such a manner as to avoid a passage to the limit whenever possible.

The first part of the book, Chapters ii–vi, aims at a systematic treatment of inequalities centred round the three fundamental inequalities: (1) The theorem of the arithmetic and geometric means; (2) Hölder's inequality; (3) Minkowski's inequality, namely,

$$\mathfrak{M}_n(a) + \mathfrak{M}_n(b) > \mathfrak{M}_n(a+b),\ n > 1,$$

where the symbols refer to the weighted mean

$$\mathfrak{M}_n(a) = \left(\frac{\Sigma pa^n}{\Sigma p}\right)^{\frac{1}{n}}$$

The apparently exceptional position of the geometric mean is elucidated by theorem 3, where the geometric mean is shown to be

$$\lim_{n \to 0} \mathfrak{M}_n(a).$$

In Chapter iii the idea of means formed with an arbitrary function $\varphi(x)$ is introduced by the definition:

$$\mathfrak{M}_\varphi(a) = \varphi^{-1}\Big(\Sigma q\varphi(a)\Big),\ \Sigma q = 1,$$

the arithmetic and geometric means corresponding respectively to the functions x^n, $\log x$. The question of the comparability of two means formed with functions $\varphi(x)$, $\psi(x)$ leads to a discussion of the properties of convex functions and to generalisations of Hölder's and Minkowski's inequalities.

In Chapter v, theorems relating to finite sums are extended to infinite sums, the general conclusion being that such extensions are valid in so far as they retain significance. The corresponding extensions for integrals are carried out in Chapter vi. A simple example of the avoidance of a passage to the limit is furnished by the proof of Schwarz's inequality

$$\left(\int fgdx\right)^2 < \int f^2dx \int g^2dx,$$

which follows from the statement that the quadratic form

$$\int(\lambda f+\mu g)^2dx = \lambda^2 \int f^2dx + 2\lambda\mu \int fgdx + \mu^2 \int g^2dx$$

is positive and therefore has a negative discriminant. Equality can only arise when constants λ, μ, not both zero, exist such that $\lambda f + \mu g = 0$. When the integrals are Lebesgue integrals, this means that $\lambda f + \mu g = 0$ almost everywhere. By adopting Lebesgue-Stieltjes integrals (which include sums) the statement of dual theorems for sums and integrals can be avoided, and the theorems stated for integrals only.

The remaining four chapters constitute a series of essays on subjects suggested by the first six, and are intended as an introduction to certain fields of modern research. These chapters are full of interest and make accessible a large number of results scattered in mathematical periodicals.

Chapter viii deals with some properties of multilinear and bilinear forms, with interesting particular theorems on forms in [2, 2] Hilbert space. Incidentally, the y_j at the top of page 213 should be x_j.

Chapter ix contains a valuable discussion of Hilbert's inequality with its analogues and extensions. Hilbert's inequality is

$$\Sigma\Sigma \frac{a_m b_n}{m+n} < \frac{\pi}{\sin(\pi/p)}(\Sigma a_m^p)^{1/p}(\Sigma b_n^{p'})^{1/p'}$$

where $p > 1$ and $p' = p/(p-1)$. Much work had to be done before this final form was attained. The theorem is made to depend upon a more general result, due to the three authors, of which an elegant proof is given. The constant $\pi \operatorname{cosec}(\pi/p)$ is the best possible, that is to say, it cannot be replaced by a smaller number.

Chapter x deals with rearrangements. The simplest problem of this kind is to find the arrangement of the sets (a), (b) which makes Σab greatest. The answer is, of course, when the two sets are monotonic in the same sense. The corresponding extensions to three or more sets, and the idea of rearrangements of functions of a continuous variable lead to extremely subtle and entertaining arguments.

The authors are to be congratulated on a masterly presentation of a subject which is as fascinating as it is useful to the mathematician. The applied mathematician will be interested to see theorems 216, 217, 218.

The printing is excellent, but it is a pity that bolder type was not used to distinguish the numbers of the theorems, which are in the same type as the paragraph numeration and exasperatingly difficult to find.

The book will form an indispensable addition to every mathematician's library.

L. M. M-T.

Grasses

The Gramineae: a Study of Cereal, Bamboo and Grass

By Dr. Agnes Arber. Pp. xvii+480. (Cambridge: At the University Press, 1934.) 30*s*. net.

GRASSES probably now constitute quite as large a family as the orchids, and no group of flowering plants includes so great a number of individuals as the Gramineæ. They are by far the most important from an economic point of view, whilst many botanists regard them as representing the peak of evolution among flowering plants. For grasses are found almost everywhere, occurring in nearly all phanerogamic plant-associations. They are, indeed, a *climax* group, not only as regards structure, but also as units of vegetation; and their origin and evolution are subjects for profound study.

Dr. Arber's work on the grasses approaches the subject from many points of view, any one of which would apparently supply material for an independent treatise as large as or larger than that under review; but in this work greater emphasis is laid on the morphological and anatomical aspects of grasses—subjects the author has studied for many years. It is a most interesting volume, not only to the expert, but to the lay reader as well; and it is not easy in a limited space to deal adequately with contents so varied and comprehensive.

Two chapters are devoted to cereals the seeds of which provide food for man. These include concise accounts of the more important, such as wheat, barley, rye, maize, oats, rice and sorghum, and the less important like teff, millet and ragi (korakan). Instead of being a seasonal product, as formerly, wheat is now garnered in some part of the world throughout the year, even at the equator, as in Kenya Colony. Although Dr. Arber says that the origin of the common millet, *Panicum miliaceum*, is unknown and quotes the classical work of De Candolle in suggesting the Egypt-Arabian region as its home, it is very probable that its wild prototype is represented by *Panicum callosum* from Abyssinia. The role of sorghums in tropical agriculture is briefly dealt with. The wealth of varieties brought to light during recent years, however, reveals their prime importance to the native races in Africa and India. There seems no doubt that the pearl millet is of polyphyletic origin, as the numerous races found in tropical Africa present very diverse forms in regard to habit and structure. Africa, as suggested, may have been the home of some of the cultivated rices, as it is the home of most of the sorghums and pearl millets. Numerous wild species of rice occur in that continent, and in recent years another species of rice (*Oryza glaberrima*) has been found in cultivation in Upper Guinea.

The next chapter considers briefly pasture, sugar and scent. The quest for "pastures new" has been intimately connected with the migration of races of mankind, and the search for new grasses still goes on.

Four chapters are devoted to the bamboos, and it is interesting to read that in the Far East young bamboo sprouts, 3–5 inches in diameter, are like giant *Asparagus* and similarly used as a vegetable. Indeed, various kinds of bamboo are employed in an astonishing number of ways, from whet-stones to musical instruments, and even to drain-pipes (see p. 59). The chapter (vi) dealing with the interesting phenomenon of the periodic flowering of bamboos is very ably written, and many interesting features are brought into prominence. Some species only reach the sexual reproductive phase after a prolonged juvenile period, which may find expression in a definite term of years, but may be speeded up or retarded a little according to environment. Thus large forests of bamboos are periodically annihilated. Even plagues of rats are caused by this periodic flowering of the bamboo, for it is recorded (p. 91) that in Brazil these plagues synchronise with the fruiting and dying of a species called 'taquara', which abounds in the forests, each cane bearing about a peck of edible seeds resembling rice. The total quantity is enormous, and large areas are often covered to a depth of 5–6 in. with the fallen grain.

In her chapter on the relative age of woody and herbaceous plants, Dr. Arber makes no reference to a recent classification of the Dicotyledons (Hutchinson, "Families of Flowering Plants", vol. 1, 1926), in which it has been shown that most woody plants and herbs have arisen independently, and have been evolved side by side as parallelisms, the Magnoliaceæ and Ranunculaceæ being regarded as the most primitive, and examples of parallelism rather than close relationship. No such parallelism in regard to habit is to be found in Monocotyledons. Such monocotyledonous plants as are woody or sub-woody are much advanced in other ways, the yuccas, palms, agaves, etc., being familiar examples, and the more primitive Monocotyledons are all herbs. As the grasses are predominantly herbaceous, it seems most probable, therefore, that the woody members

which occur in the Bambuseæ are the most advanced of that tribe. For there are several herbaceous members at present assigned to this tribe with more primitive flower structure than that of some of the woody genera. These are *Guaduella* and *Puellia*, with short creeping rhizomes, herbaceous culms, broad, flat, transversely veined leaves, and trimerous flowers (with three lodicules and six stamens).

In the final chapter of the series on the bamboos, a summary is given of the author's valuable researches on the so-called anomalous genera *Streptochæta* and *Anomochloa*, which have been placed in various tribes by different authorities. Two separate tribes for these two genera have recently been constituted by C. E. Hubbard (Hutchinson, "Families of Flowering Plants", vol. 2, 1934). *Streptochæta* is primitive in the possession of six stamens, a trifid style and a perianth almost equivalent to that of some Liliaceæ, and not resembling the familiar type of lodicule. *Anomochloa* is one of the most peculiar of all grass genera; in fact Dr. Arber is tempted to doubt whether it is really a member of the grass family at all. It much resembles certain Marantaceæ, whilst its floral structure is still imperfectly known, the lodicules being probably represented by a hairy ring round the stamens.

The constituent organs of the reproductive shoot have been the subject of much controversy. In her consideration of this portion of the grass plant, Dr. Arber first deals with the various types of inflorescence, leading on to its units, the spikelets. The structure of the latter often presents difficulties of interpretation owing to the reduction, modification or suppression of individual organs. The microtome technique employed by Dr. Arber and other workers has, however, in some cases assisted in solving these difficulties. The author describes all parts of the spikelet from a structural point of view, and follows it by an account of the method of flowering and seed production. Protogyny is considered to be rare in grasses, occurring in those which have no lodicules, such as pearl millet and meadow foxtail. She suggests that protogyny and lodicule suppression are interconnected, because the later emergence of the anthers is due to the difficulty of forcing the flowering scales apart, a function usually performed by the lodicules. In many genera the spikelets have been subjected to compression, causing reduction or suppression of some or all of the sexual organs, and even of some of the glumes, lemmas and paleas. A series of examples of sterilisation may be seen, commencing with *Hierochloë*, in which the lateral florets are male, and ending in *Phalaris*, in which they are reduced to rudimentary or very small lemmas. Even the branches and branchlets of an inflorescence, as in *Pennisetum* and *Setaria*, may be entirely reduced to bristles.

Several chapters deal with the vegetative morphology of the grass plant from the germination of the seed to maturity.

Chapter xv discusses the distribution and dispersal of grasses, which are found in all parts of the world, from the humid tropical forests to the regions of perpetual snow. They are formidable competitors in the struggle for existence, and are usually capable of ousting other herbaceous plants. This is due mainly to their mode of growth and their adaptability. Only two flowering plants are known to penetrate the Antarctic, and it is interesting to note that one of these is a perennial grass, *Deschampsia antarctica*. Some genera show a remarkable range in altitudinal distribution; for example, very closely related species of *Festuca* occur from sea-level up to nearly 18,000 ft. The varied conditions under which they grow are probably not equalled by any other family. Besides the aquatic grasses, some typically terrestrial species will bear long periods of submersion in water, whilst the opposite extreme is to be found in those which are capable of withstanding extreme heat and drought, such as occur in desert regions, as, for example, *Spinifex paradoxus*, one of the dominant species in the Sturt Desert of Australia, and various species of *Aristida* in the Libyan Desert. Sand-binding grasses have been of great importance to man. Their use in preventing erosion in Great Britain was realised in very early days, for an Act of Parliament in the time of Queen Elizabeth decreed it illegal for the marram grass (*Ammophila arenaria*) of our sand-dunes to be eradicated.

The reclothing of devastated areas by volcanic action is discussed by the author, who records that in the case of the island of Krakatau, doubt has been thrown on whether all plant-life was actually destroyed, and that probably some grasses in the form of their rhizomes or seeds may have survived, thus rendering the methods of their reintroduction open to question. The study of the methods of distribution of many grasses reveals some astonishing adaptations of both vegetative and reproductive organs for dispersal. Sometimes whole plants are carried considerable distances by wind or water. Besides those mentioned by Dr. Arber, it is interesting to note that at least one grass, *Stenotaphrum secundatum*, which grows along seashores in the tropics, probably owes its wide distribution to the fact that its runners and rhizomes are torn up and dispersed by the waves. In a number of cases the entire inflorescence, when ripe, disarticulates from the culm and is blown about by the wind, such as the well-known

Spinifex squarrosus, and some of the Australian 'umbrella-grasses', including species of *Digitaria* and *Chloris*. The spreading of seeds is effected in numerous ways; in many cases the parts of the spikelet bear hairs which at maturity form a spreading plume enabling the seed to be carried by the wind; in other cases, dispersal by wind agency is due to the diminutive size of the seed or to specially modified glumes and lemmas.

As the author states, unintentional conveyance by man and animals is responsible for the wide distribution of some grasses, especially those which have become serious pests in grazing land, like species of *Cenchrus* and *Tragus*, which are armed with barbed bristles.

The rather fancy title of "Pattern and Rhythm" lays stress on the homogeneity of the grass family as compared with others, and the numerous parallelisms which exist, not only between different species, but also between species in different genera, and their resemblance to other families.

Because of recent works, Dr. Arber has limited her remarks on the systematic aspects of grasses to a taxonomic table of the genera referred to in the book (p. 410), whilst ecological notes are only incidental.

Dr. Arber is to be warmly congratulated on the production of a very attractive book, in which is collected a mass of information bringing together a summary of her numerous contributions on the family. There is a wealth of illustrations, a large proportion of which are drawings of microtome sections, the value of which would have been greatly enhanced, while they would have been more easily understood by the general reader had they been always accompanied by a text-figure of the plant itself.

Ministering to Minds Diseased

Psychology and Health
By Dr. H. Banister. Pp. viii+256. (Cambridge: At the University Press, 1935.) 7*s*. 6*d*. net.

THE influence of the physical state of the body on the mental outlook has long been recognised—and a timely cathartic has often proved effective in dispelling a morbid and gloomy philosophy of life. But physical remedies are not always effective in combatting physical ills, as is witnessed by the case, treated by Dr. Banister, of a patient suffering from insomnia, who had, during seven years ordinary treatment, consumed gallons of soporific drugs without appreciable effect. Psychological treatment based on two visits of about an hour each brought about a complete cure.

It is possible that, as a class, medical men of the last generation tended to take what is termed a materialistic view of their science; it is more likely that, in medicine as in other branches of science, the supremacy of Dr. Stoffkraft was not long unchallenged. Indeed, many wise men and many wise physicians have long recognised, in health and in disease, the importance of the individual, and the controlling power of his mentality.

Surface psychology—which is anything but superficial—in its relation to the art of living is no new branch of knowledge. In unsystematised fashion, it has long been known. It may be studied daily in the lives of those around us by him who is equipped with the right sympathies and the appropriate background; it may be followed in the records of the lives of those men, obscure or famous, who have seen life steadily and seen it whole; in the pithy sayings of Poor Richard, and of other more cultivated, but not necessarily wiser aphorists. Vauvenargues, La Rochefoucauld and Pascal can teach much to him who has the germ of an understanding mind. Think of Pascal's pregnant but bitter saying, "La curiosité n'est que la vanité. Le plus souvent on ne veut savoir que pour en parler"; with the saying in mind, listen to the next debate or discussion, take note, indeed, of one's own contribution, and recognise the truth which the aphorism enshrines.

The art of living is undoubtedly an art difficult to learn or to teach, but it has been taught, albeit unsystematically; it has been learnt; and the psychologist who will read his Boswell understandingly may learn much of the art as taught by his predecessors—especially if he will resist the temptation to estimate Johnson's intelligence quotient.

But we must return to the details of Dr. Banister's valuable treatise, which is concerned mainly with the treatment of the sick by psychological means and with the helping of those who, on a superficial view, may seem to be whole, but yet are suffering from such maladjustments to their environment as may be cured by an application of that most difficult art of taking thought—and of taking thought in a very special way.

After some preliminary discussion and definitions, chapters are devoted to the problem child,

infantile sexuality and allied matters. The troubles of the healthy and of the invalid are then discussed—succeeding sections deal with suggestion, hypnosis, the unconscious and dissociation, conversion hysteria, anxiety states and compulsions and obsessions. About thirty pages are devoted to a consideration of the views of leading Continental psychologists, and the book closes with three valuable chapters devoted to methods of treatment.

Dr. Banister's book should be considered as, primarily, a laboratory manual; it contains details of many cases and of modes of treatment which should prove of great value to medical students and to general practitioners—and not of least value to him who has already, in the light of his own reason, applied psychological knowledge to his own cases; he, indeed, will welcome a co-ordinated statement of psychological truth told in plain and simple language.

It is to be hoped that, in a second edition, case-details will bulk more largely than they do in this first edition. Despite the emphasis laid, and rightly laid, on the importance of the individual, it is a great encouragement to a young and untried student to find that instances exist which may help to explain some of his own difficulties.

A number of students of psychological method have been repelled by the obscure phraseology and jargon of the protagonists; not the least useful section of Dr. Banister's book is that which gives a succinct exposition of the theories of Freud, Janet, Jung and Adler.

Psychology has come to stay; and the book should certainly find a place on the shelves of the student of medicine—it will prove to be a very serviceable guide to those who will shortly be called to face the difficulties and decisions of a general medical practice. A. F.

Electrons

Electrons (+ and −), Protons, Photons, Neutrons and Cosmic Rays

By Prof. Robert Andrews Millikan. Pp. x+492. (Cambridge: At the University Press, 1935.) 15*s*. net.

THE appearance of a new edition of Prof. Millikan's well-known book "The Electron" will be welcomed by the many students of physics for whom the previous edition has become a standard text. The new edition differs from its predecessor both in its title and in the addition of six chapters dealing with recent advances in atomic physics, but the first ten chapters are essentially a reprint of the second edition of "The Electron" from which, at the request of the publishers, they differ only in minor details. It is a remarkable testimony to the previous presentation of the subject matter that new chapters can be added to the existing text with no apparent hiatus in the development of the book.

The first ten chapters contain, therefore, among other matters, an account of the circumstances which led to an accurate determination of the atomic charge. Beginning with the fundamental facts of electrolysis, the author proceeds to describe the first attempt at a direct determination of the atomic charge made by Townsend, involving the use of Stokes's formula to determine the size of small drops. He discusses the adoption and improvement of Townsend's method successively by J. J. Thomson and H. A. Wilson and finally describes his own classic investigations on the value of the atomic charge and on the atomic nature of electricity.

Among other matters considered in detail in these early chapters are the Brownian movement in gases, the nature of radiant energy and the structure of the atom. Had changes in this part of the book been permitted, some reference to the Auger effect would no doubt have been made in the chapter on the mechanism of ionisation in gases, and also to the recent accurate determination of the atomic charge made in Prof. Regener's laboratory by E. Schopper, using a method based on that of Rutherford and Geiger and of Regener.

Among the six new chapters there is one on particles and waves, which treats in a simple but lucid manner particle-wave dualism in modern physics; and another on the spinning electron, with special reference to the work of Millikan and Bowen on the spectra of stripped atoms and to the new spectroscopic rules. There are admirably informative chapters dealing with fascinating topics such as the positron, the neutron, artificial transmutation and induced radioactivity.

Perhaps the least satisfactory section of the book is the chapter on the nature of the cosmic rays. In a work of this scope it would perhaps have been more useful to have given a general summary of contemporary investigations rather than to have indulged in a detailed analysis of particular investigations with which the author

has been associated, interesting and important though these are. The treatment of the subject matter appears to be directed towards establishing the hypothesis that the primary radiation is composed principally of photons, a view of its nature not generally accepted. Consequently, other investigations are treated somewhat summarily. For example, Clay's discovery of the latitude effect and Compton's organised world survey which confirmed it, receive but scanty treatment, whereas several pages are devoted to Prof. Millikan's recent surveys. No mention is made of the double-counter type of experiment introduced by Bothe and Kolhörster except in connexion with the east-west effect, of Regener's recent results with a Geiger counter in the stratosphere, or of the important observations of Kolhörster, Clay and Corlin on the penetration of the radiation into the earth and the sea. The inquiring student would be advised to supplement this chapter by reference to brief summaries of the subject such as those by Blackett and Corlin.

The book is throughout profusely illustrated, and particular mention must be made of the many beautiful expansion chamber photographs which illustrate the sections on modern atomic physics, while in spite of the somewhat dogmatic style, it is an extremely readable and lucid summary of a wide field of investigation.

The publication of a book by an authority of the standing of Prof. Millikan, whose own important researches cover a wide field, must be regarded as a notable event, and this book proves to be an important addition to the literature of atomic physics and a worthy successor to his classic work "The Electron". L. G. H. H.

The Science of Rubber ("Handbuch der Kautschukwissenschaft")
Edited by Prof. K. Memmler. Authorized English translation, edited by Dr. R. F. Dunbrook and Dr. V. N. Morris. Pp. xvi+770. (New York: Reinhold Publishing Corporation, 1934.) 15 dollars.

THE text of this publication consists of English translations of memoirs on the following scientific aspects, as distinct from the manufacturing technology, of rubber: botany, cultivation, preparation and collection (Zimmermann), chemistry (Pummerer and Koch), vulcanisation (Kindscher), chemical-analytical testing methods (Kindscher), physics (Hock), physical testing (Memmler and Schob) and microscopy of technical vulcanisates (Pohle). Edited in German by Memmler in 1930, it has now been translated and brought more up-to-date by the members of the Research Staff of the Firestone Tyre and Rubber Company under the general authorship of Dunbrook and Morris.

It is not possible in this short notice more than to touch on the general features of the publication, which is a signal addition to English rubber literature. The subject matter of the text fills 675 pages. It is well illustrated and so adequately referenced as to make it encyclopædic in its scope. The authorship of each of its sections is authoritative. The translations are smooth. Most of the sections have been amplified by the American editors, but the botanical section could have been made more complete by the inclusion of recent work on variability and propagation.

The specialist, for it is to him that the book will have appeal, will find a use for the book no less for its bibliography, its author- and subject-indexes, than for the text itself. The indexes are models of completeness. There is no such thing as difficulty in finding one's way about the publication, and we doubt if even the specialist scientific worker will find any work of major importance unrecorded. The publication represents a piece of team work of unusual merit and something all too rare in the rubber industry. Its success, despite its high price, is assured.

G. E. C.

Gardening in East Africa
A Practical Handbook by Members of the Kenya Horticultural Society and of the Kenya and Uganda Civil Services. Edited by A. J. Jex-Blake. Pp. xv+330+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 12*s*. 6*d*. net.

INNUMERABLE books on gardening have so ingrained it in our minds that a garden is a place in which plants from warmer climes are made to flourish in spite of our English winter, that the converse comes rather as a surprise. In this volume, the members of an English horticultural society describe their successes and failures in growing English garden-plants, with others, so near the equator as Kenya. It is a practical handbook that will be useful to gardeners in sub-tropical countries all the world round. The scientific aspects of the local horticulture are discussed in introductory chapters on climatology, soils, economic entomology and mycology, treated in a popular way, but containing a valuable body of knowledge for so young a colony as Kenya.

In a further edition more will doubtless be said about soil amœbæ, which play so important a role in most soils, and there will be need of more editorial co-ordination, for example, when the 'eel worm' has been described as a "parasitic worm" on p. 25, it should not be necessary to state on p. 310 that it is not a "vegetable", nor yet an "insect". The delightful plates are by the Misses M. Collyer and E. Napier. Lady Muriel Jex-Blake is responsible for two attractive chapters on flowering plants and shrubs and on climbing plants, while Mr. V. A. Beckley, senior agricultural chemist, has added chapters on the soil and on manuring and tillage. The foreword is by Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, who has not long returned from a friendly visit to South Africa, and is well aware of the difficulties of tropical horticulture, only to be overcome by the virtue of charity in the sharing of plants and experiences.

Patterns of Culture

By Ruth Benedict. Pp. xiii+291. (London: George Routledge and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

DR. RUTH BENEDICT, in a stimulating and at times provocative book, has imported the theory of relativity into the study of social anthropology, which she, like some others, regards as the whole of anthropology. She argues that in the study of cultures, European spectacles and European standards must be abandoned, and the elements of any given culture under inspection evaluated exclusively in the terms of the culture to which they belong. How this works out in actual practice is demonstrated by a study of three strongly contrasted cultures, that of the Zuñi Indians of New Mexico, of the natives of Dobu in Melanesia and the Kwakiutl of Vancouver Island. In the case of each, she shows the characteristic reaction produced by analogous circumstances in contrasting social conditions.

In demonstrating her theories, Dr. Benedict shows much originality and freshness of outlook. Her general position, however, in its stress on the relativity of cultural elements, does not in the long run get much beyond what the now much criticised 'evolutionary' anthropologist meant when he insisted upon sympathetic understanding in the study of the culture of backward peoples when construed in terms of their environments, even though he may have erred, according to the modern view, in regarding that environment as representing a stage in the development of culture.

The Struggle for Existence

By G. F. Gause. Pp. ix+163. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1934.) 13*s*. 6*d*.

THERE is no doubt as to the interest of biologists in all questions relating to populations and the struggle for existence. The author attacks these both as an expert mathematician and as a biologist, which his work shows to be a necessary combination. In animals, the processes in the struggle are much more complicated than in plants, where certain principles seem likely to be enunciated within a few years. Population growth requires to be studied together with its limiting factors, and this is further developed in chapters relating to the competitions both between species of yeasts and between species of *Paramecium*. Then follows a study of two species one of which devours the other, the chain here being Bacteria → *Paramecium* → *Didinium*. In Nature there can be no constancy of conditions; perpetual interferences, proved to be often due to immigrations, allowing no constancy of results.

Such investigations give ideas and stimulate that spirit of inquiry that rightly appeals so strongly to the younger biologists of to-day. The price (13*s*. 6*d*.) is too high for the ready sale that this book deserves; the American price is 3.00 dollars, so that this is only the fair exchange rate, whereas scientific books published in England are often priced at 50 per cent more than the exchange justifies in the States, a difference that kills their sale.

Through my Telescope: Astronomy for All

By W. T. Hay. Pp. xiii+128. (London: John Murray, 1935.) 3*s*. 6*d*. net.

THIS book, as its title suggests, is chiefly concerned with observational astronomy, although a sufficient background of astronomical facts is included to enable an intelligent interest to be taken in the objects observed. There is, in fact, a surprising amount of information compressed into its small space. The main theme, however, is the pleasure to be derived from, and the scientific value of, systematic observation of heavenly bodies with moderate instrumental equipment. The illustrations are from drawings by the author, and the plates give excellent ideas as to what one may expect to see in a medium-sized telescope—being far better for this purpose than photographs, which frequently give rise to disappointment at the telescope. The final chapter gives hints as to the use of telescopes, and the whole book should be an encouragement to many to follow the author's example in becoming regular astronomical observers.

Wandlungen in den Grundlagen der Naturwissenschaft: Zwei Vorträge

Von Werner Heisenberg. Pp. 45. (Leipzig: S. Hirzel, 1935.) n.p.

THE separate publication of these two lectures, which appeared in different periodicals in 1933 and 1934, directs the attention of a wider circle of readers to the views of one of the leading physicists of the day on natural knowledge. It is not without pride that Heisenberg reviews the field already conquered by modern physics. But in all humility he does not think that these conquests have brought us any nearer to the understanding of reality, because of the mathematical character adopted by natural philosophy. Pure speculation, on the other hand, can no longer claim attention if it ignores the formal results of scientific investigation. At present, the way to know Nature should be left for everyone to find individually, unless we wish to hope that the future will provide us with a single method satisfying all points of view. T. G.

British Industries and their Organization

By Prof. G. C. Allen. Second edition. Pp. xi+338. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 10*s*. 6*d*. net.

IN the second edition of this most readable book (cf. NATURE, 133, 153; 1934) Prof. Allen extends his stocktaking of the major industries of Great Britain and their organisation to cover the years of the depression up to 1933. The statistical tables and bibliography have been brought up to date and the discussion of the far-reaching changes in economic policy during the last five years as well as of the course of Government action in the coal, the iron and steel and the cotton industries considerably enhance the value of the book to those who seek a broad view of these most important problems.

Neglect of Scientific Direction in Industry

Lessons of the Depressed Areas

IN January last a deputation representing the local sections of the Institute of Chemistry, the Chemical Society and the Society of Chemical Industry was received by Mr. C. Forbes Adams, the District Commissioner for Depressed Areas at Newcastle-upon-Tyne. Following on that meeting it was agreed to prepare memoranda on science and industry, coke, barium and other minerals, organic chemical developments and the ceramic industries, with the idea of directing attention to developments likely to lead to a permanent and progressive revival of employment in the area, and particularly to factors of fundamental importance from the technical point of view.

These memoranda have now been presented to the District Commissioner, and a further report on services to industry has yet to be completed. Together they provide a valuable commentary on the recently published first report of the Commissioner for the Special Areas*. The latter report deals with the general position of the special areas and the measures required if the problem is not to be allowed to become insoluble. The outstanding need on which it insists is that of establishing conditions whereby industry will be attracted to, instead of repelled from, these areas. It is suggested that the initial effort should come from within by the creation of local markets to be supplied by local production. To support local initial effort, Government grants to influential and widely representative development councils will be required to give them every opportunity of planning reconstruction. While this is being effected, the areas must be relieved of all excess burdens, and the special measures now being applied continued and strengthened. Resident district commissioners are essential to watch over the interests of the areas on behalf of the Government, to further local co-operation and to secure co-ordination in all fields of activity. Local efforts and the assistance possible under the Special Areas Act require supplementing by wider Government measures designed to reduce unemployment generally.

The further proposals of the general report in regard to transference out of the special areas, raising the age of entry into industry to sixteen, contributory pensions and earlier retirement from industry, shorter working hours and holidays with pay are obviously palliatives, wise in themselves but secondary to the question of finding work through the expansion of industry and creation of production. If, however, there is to be progressive industrial development in these areas, with full utilisation of their natural resources, scientific direction and research are essential. For this reason the adoption of the recommendations of the Joint Committee was urged on the District Commissioner for Durham and Tyneside.

The report on science and industry is signed by Dr. J. T. Dunn and Prof. G. R. Clemo, who, in support of the contention that the best possible scientific direction of industry is not exercised on Tyneside to-day, quote the case of a local firm which, after putting a new material on the market, found its behaviour in use was unsatisfactory. This could have been predicted if measurement of one of its fundamental physical properties had been made. The need for this was neither realised nor understood; nor, in fact, was there anyone on the staff competent to carry out the essential simple measurements. Lack of co-operation between actual business concerns in the area is another serious handicap to development, materials being bought from other areas which could as easily be, and actually are, produced in this area. As stressed in the Commissioner's report, the stimulation of local consumption of local production is a most important factor in the development of all the special areas.

Prof. Clemo and Dr. Dunn comment on the lack of progress in the area in recent times, apart from the great enterprise at Billingham, and this is reflected in the absence of local exhibits at the British Industries Fair. An even more significant pointer is found in the employment of scientific graduates in local industries. Of a total of 184 honours graduates in chemistry from Armstrong College in the fifteen years ending in 1934, only 12 (or 6·5 per cent) are known to have obtained industrial employment locally, 6 being with coal concerns, which number might have been greater had Armstrong College a Department of Fuel Technology. The situation is even worse in other pure sciences, such as physics, where only one out of 39 graduates during the last five years obtained industrial employment. In the applied sciences, although about 85 per cent of the students of electrical engineering are attached to works before entering college, only 20 per cent at most of these men are to be found holding posts locally five years

* First Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 4957.) Pp. viii+106. (London: H. M. Stationery Office, 1935.) 2s. net.

after graduating. Although definite figures are not available for other provincial universities, the opinion is expressed that elsewhere the position is very different.

Replies to inquiries whether chemists from other universities have obtained posts in this area during the last five years are incomplete, but with the exception of Billingham, no such appointment is known. Further, although the record of only 166 of the 184 honours graduates in chemistry is available, it is known that 20 occupy posts in universities or technical colleges, 77 in schools, and at least 37 occupy research or administrative posts in industry elsewhere; thus indicating that the right type of man is turned out in the area.

Prof. Clemo and Dr. Dunn accordingly urge that neglect of research is one reason why the area, in spite of its great natural advantages of coal and other valuable raw materials, combined with its favourable position, is in its present sorry plight. These advantages and its position relative to the forests of Norway and Sweden should have put the area in the forefront of the rayon and paper-making industries had the opportunity been seized some forty years ago.

The north of England did extremely well during the first part of the industrial revolution, and the alkali industry, founded and carried on by men who made the best use of the science of their time, was for long a source of prosperity to the district. The greatest factor in the subsequent decline has been the narrow outlook, which failed to see that industry is based on science, and that a policy which drains the profits and leaves insufficient reserve for research and development is doomed ultimately to failure.

This is more than ever true to-day, when Britain no longer holds her privileged position of a hundred years ago, and has to meet the competition of other nations who have improved their training and are applying intensively the results of research and scientific discovery to the improvement and cheapening of their products. As evidence that the importance of industrial development has been less fully recognised in this district than in other parts of Great Britain, reference is made to the absence of chairs or laboratories established and endowed by industrialists such as are to be found at Liverpool and Manchester. There has been no such full realisation in the area that new industries have sprung from pure research undertaken from non-utilitarian ends in university institutions.

It is concluded that general prosperity in the district will be impossible without an extensive application of scientific methods to those industries which the local raw materials and situation make possible. Eight years ago, for example, the attention of the Chamber of Commerce and of the Tyneside Industrial Development Board was directed to several important new developments in coal products which were anticipated during the new decade. Several of these are now established processes—but elsewhere. Among the memoranda prepared under the guidance of the joint committee, that on coke directs attention to the desirability of an inquiry into the possibility of utilising the gas at present wasted at the coke ovens in the area, and in regard to the development of a coke for domestic purposes. The memorandum on barium stresses the need for an investigation on the possible uses of witterite. Another recommendation which indicates possibilities of development is that of the memorandum on the fishing industry, which calls for systematic investigation through the facilities at Armstrong College in regard to the working up of by-products from this industry, including the utilisation of fish liver oils. In particular, an investigation on the composition of herring oil is required.

Other memoranda on organic chemical developments suggest that a moulding industry could profitably be established in the district, although the manufacture of the actual resins and research in that should be left in the hands of the larger chemical firms of the country. Opportunities afforded to the local glass and ceramic industries are indicated, the seizing of which involves a strict scientific control of manufacturing processes, with some research work on both the improvement of existing products and the development of new lines, as well as adequate artistic guidance and the establishment of co-operation with local schools of art. Reference is also made to possibilities in the fire-proofing of timber and the preparation of sulphite pulp for paper making.

In the final section of their memorandum, Prof. Clemo and Dr. Dunn refer to the need for further endowment of Armstrong College, if it is to play its full part in restoring greatness to the area and particularly in research with a definite bearing on local industries. The technical colleges of the area cannot play their part in the development of local industry if they are hampered by lack of adequate equipment or staff. Their work is intimately related both to pure research and to the needs of industry. At one end of the scale they supply industry with young men well trained in the fundamental principles of their own branch of industry, who can therefore rapidly adjust themselves to the working conditions imposed by new discoveries; at the other end, they are teaching students to recognise and interpret their everyday work in the light of some guiding principles, with obvious gains to students and to industry.

Wallace's Line and the Distribution of Mammals

THE very definiteness of 'Wallace's Line', which threads its way with precision, though without much apparent geographical reason, between Borneo and Celebes and between the almost contiguous islands of Bali and Lombok, and so marks the boundary between the Oriental and Australian zoogeographical regions, must have raised a doubt in the mind of many a zoologist; and sometimes the doubt seems to have been justified. In an introduction to the most important analysis which has been made in recent years of the facts of mammalian distribution bearing upon the authenticity of Wallace's boundary*, Dr. W. K. Gregory cites two serious criticisms.

An examination of the fauna of the East Indian Archipelago led P. N. Van Kampen in 1909 to a very definite conclusion. "According to the researches of more recent times, among which should be mentioned especially those of Von Martens, Max Weber and the Sarasins, it becomes evident that such a sharp boundary as Wallace drew does not exist. Not only is there none where he drew it, but no such line exists anywhere in the Archipelago. Of course it is possible to draw such a line which apparently bounds the distribution of some single group; . . . But taking the fauna as a whole it is certain that no line may be drawn; but, rather, we may lay out a transition zone in which the fauna of India and that of Australia are mingled, and wherein from the west to the east the Australian components increase more and more in number; and on the other hand, the Indian tend to die out." Van Kampen regards all the transition region as being essentially linked with the eastern half of the Archipelago, that is with Wallace's "Australian" half, although he insists that even the boundaries of the transition region are not sharply defined.

More recently, W. D. Matthew (1915) proposed another solution which in effect obliterated Wallace's boundary as the Oriental-Australian divide. He created a new sub-region—Australo-Malaya—which included the islands east of the 'Line', "the debatable ground between the Oriental and the very distinct Australian region", although "the consensus of opinion classes it by preference with the Australian".

Now Henry C. Raven enters the debatable ground and, as the result of a very thorough study of the mammalian fauna, finds new support for the old 'Line'. He has some right to express an opinion, for from 1912 until 1918 he collected mammals and other vertebrates in the Dutch East Indies for the United States National Museum, and from 1921 until 1923 he carried on similar collecting in Australia for the American Museum of Natural History. Finally, he has tabulated and mapped the distribution of all the known forms of mammals in the region—2,240 species and sub-species.

The broad fact which has weighed most with critics of 'Wallace's Line' is that many creatures have broken across it in an easterly direction. Raven, therefore, analyses the list of mammals which have transgressed the supposed boundary. His tables and maps are full of suggestive information, and it amounts to this: that the mammals which have crossed in greatest numbers are the bats, shrews, true rats and mice. True squirrels crossed from Borneo to Celebes; true pigs reached New Guinea; true deer (*Cervus*) spread from Java to Celebes, but were also carried about by natives. Indeed, all the transgressions cannot be attributed to natural distribution, for man transported some of the Viverridæ, although *Paradoxurus* may have drifted over the boundary, and of other Carnivora, while one species of *Felis* reaches Sumba (not Sunba as in the text, p. 195), the dingo was man-borne. The lemur *Tarsius* and the macaques of Celebes complete the list, except for the greatest mammalian transgressor of all—man.

How does this list stand in comparison with the series of mammals which have found 'Wallace's Line' to be a real boundary? Of the East Indian forms which do not transgress the line, there are the hedgehogs (Erinaceidæ) and tree-shrews (Tupaiidæ) amongst Insectivora, the tree-shrews, with thirty-nine species, reaching Lombok and spreading along the west of the 'Line' to the Philippines; *Galeopithecus*; the Spalacidæ; the squirrels (excluding *Sciurus*), with eighty-seven species widely distributed west of the 'Line' but none crossing over; porcupines, hares and rabbits; the pangolins; amongst the Ungulates, the chevrotains (*Tragulus*) with forty-three species in the Malayan region, the muntjac deer, tapirs and rhinoceroses have all had their wanderings checked at 'Wallace's Line'. So it is with most carnivora: the dogs (other than the dingo), the single species of bear, and the Mustelidæ, of which eight genera occur in the Malayan region. Apart from the monkeys already mentioned, the Primates keep within the same limits, and they include thirty-six species of semnopitheques, fifteen species of

* Wallace's Line and the Distribution of Indo-Australian Mammals. By Henry C. Raven. *Bull. Amer. Mus. Nat. Hist.*, 78, art. iv; 1935.

Macacus, eight species of gibbons and one highly variable species of orang—all of East Asiatic origin, and none transgressing the 'Line'.

Whatever may be said about the inefficiency of the supposed boundary, it is evident that it has acted as a real barrier to far more mammals and mammalian groups than it has allowed to pass; and, in Raven's words, "this seems consistent with the fact that 'Wallace's Line' for the most part marks the eastern boundary of the ancient continent, while the islands east of it have had only occasional contacts with it. The facts suggest that those numerous families which failed to cross Wallace's Line only reached it in relatively modern times after the barrier was fully established".

Much has been done in the region since Alfred Russel Wallace published his observations and deductions in the sixties and seventies of last century, and the general run of investigation is to suggest that by narrow and temporary land bridges between deep seas, the islands of the Malay Archipelago made occasional contact with the old mainland of Cathaysia. So are explained the abundance of mammalian forms in the Malay Peninsula and Borneo, parts of the old mainland, and the relative scarcity of mammals in Celebes and the Philippine Islands, outliers of the continent. 'Wallace's Line' gains its significance and is a real boundary because it indicates the line of the continental shelf of the old mainland, and that marked the limit of distribution for most East Indian mammals. Van Kampen underestimated the significance of the 'Line', which Raven regards as being "well-established" by the distribution of mammals; this refers more especially, as Gregory points out, to the southern two-thirds of the 'Line', for the northern end, where it runs south of the Philippines, appears to mark a break of more recent formation and of less zoogeographical significance.

JAMES RITCHIE.

Royal Society of Canada

ANNUAL MEETING

THE Royal Society of Canada held its annual meeting on May 21–24 at McMaster University, Hamilton, Ontario. The presidential address by Prof. W. Lash Miller dealt with "Some Applications of the Methods of Physical Chemistry to the Study of Micro-organisms". The Flavelle Medal for 1934–35 was presented to Dr. F. T. Shutt, for his numerous contributions in the field of chemistry. The Lorne Pierce Medal was awarded to Dr. E. Montpetit, and the Tyrrell Medal to Brig.-General E. A. Cruikshank.

Prof. L. M. Gould, of Carleton College, Northfield, Minnesota, gave the annual public lecture, his subject being "Adventures in Antarctic Geology". Prof. Gould was a member of the recent Byrd expedition. His lecture was an outstanding humorous presentation of scientific facts.

In Section I (Literature française, Histoire, etc.) eighteen papers were presented, and seventeen in Section II (English Literature, History, etc.). Amongst a number of important contributions might be mentioned that of Dr. Lighthall on a newly discovered *Journal* of James and Andrew McGill. Besides supplementing greatly the hitherto scanty knowledge of James McGill, the founder of McGill University, this 522-folio-page work gives much information on the affairs of the North-West Fur Company from 1797 until 1814.

The contribution, "De l'influence de la révolution americaine dans la province de Quebec" by Gustave Lanctot, and that by L. W. Howay on "Negro Immigration into Vancouver Island in 1850", served to emphasise the ever-present problem of the influence on Canada of political changes in the United States of America.

The feature of Section III (Mathematical, Chemical and Physical Sciences), which was held under the presidency of Prof. E. F. Burton, was a symposium on supra-conductivity. Prof. Burton in his presidential address gave a summary of the general phenomena of supra-conductivity. He was followed by F. G. A. Tarr, who spoke on the magnetic effects in supra-conductors, and announced that he finds the effective permeability to be influenced by the geometrical shape of the body. A. D. Misener gave results of experiments which indicated that the transition point for thin films of lead is a function of the thickness of the film. The results of experimental work done at the cryogenic laboratory at Toronto were summarised, and this was followed by three theoretical papers on the explanation of supra-conductivity, by C. Barnes, H. Grayson Smith and Prof. L. V. King. Prof. King's theory, founded on electric polarisation and space lattices, was an important contribution; the theoretical curves for the Wiedemann-Franz relation and the effect of a magnetic field on the transition temperature

are in satisfactory agreement with experimental results.

Among the hundred and twenty-nine papers presented to the section, space permits the mention of only a few. Prof. L. V. King presented a paper on the theory of acoustical resonators in which he succeeded in obtaining an exact solution for the case of a semi-infinite cylinder bounded by an infinite flange. The agreement with Rayleigh's approximation is excellent. Dr. L. Gilchrist and his collaborators presented two papers on the results of applied geophysical work and Dr. H. G. I. Watson spoke on an improved electrical method of using the point electrode in geophysical field work. A paper by Prof. J. Satterly and J. C. Strachan on the measurement of surface tension of water and mercury by means of stationary waves on a vertical jet was the subject of an interesting theoretical discussion as a result of the values obtained for mercury by this method. Dr. Otto Maass presented a paper in collaboration with W. H. Barnes and R. S. Brown giving the results of determinations of the specific heat of liquid D_2O from 0° to 100° C. Among the several papers by Dr. O. Maass and his associates, mention may be made of an interesting investigation on the dielectric constants of propylene and methyl ether for both the liquid and vapour forms from room temperature to 10° C. above their critical temperatures. A definite difference in dielectric constant of liquid and vapour has been found to persist above the critical temperature.

Dr. J. A. Gray and J. S. Marshall presented papers on the scattering of β-rays in which the loss of energy by a homogeneous beam scattered through an angle of approximately 90° is measured and the absorption in aluminium of homogeneous β-rays determined. Further results on the study of pleochroic haloes were presented by Dr. G. H. Henderson. Evidence for instabilities resembling eddies in the striated discharge from measurements made using a small Rayleigh disc was given in a paper by Dr. D. A. Keys. Dr. G. M. Shrum gave an account of a method of finding the vitamin A content of pilchard oil from the absorption spectrum. Dr. D. C. Rose read an interesting paper summarising the results of a series of continuous records of atmospheric potential gradient, taken at Ottawa, which show a relation between weather conditions and the deviations from the average type of diurnal variations. In a paper presented by J. O. Wilhelm, A. D. Misener and A. R. Clark, the results of viscosity measurements on the two forms of liquid helium were given. Helium I at 2·3° K. has a viscosity of 0·00027 C.G.S. units and helium II at 2·2° K. has a viscosity of 0·000033 C.G.S. units, which is not very different from that of helium gas. Several papers on spectroscopy, particularly on the hyperfine structure of lines, were presented by Dr. Stanley Smith, A. B. McLay, M. F. Crawford and others.

An exceptionally interesting series of papers was presented in Section IV, and the following list of subjects discussed indicates their wide range of geological interest:

Physiology of northern British Columbia; the deformation of post-glacial lake terraces in Ontario; problems in stratigraphy in the complex series of southern Quebec; a late Cretaceous fauna of southern Alberta; a revision of the genus *Tetradium*; a revision of the genus *Calapoecia*; a discussion of Archæo-cyathinæ; the differentiation and structural history of the Sudbury Nickel Irruptive; heavy accessory minerals in granites; igneous breccias; new types of pleochroic haloes and their causes; the composition of asbestos and related fibres; rock flour glacial 'White Silts' in southern British Columbia; fabric analysis in structural petrology; and geological deductions from deep focal earthquakes.

The meeting was brought to a fitting close by an excursion to examine the interesting geological features in the vicinity of Hamilton.

Prof. John Tait in his presidential address to Section V (Biological Sciences) spoke on "Some Structural Implications of the Respiratory Mechanism in Animals", and illustrated his viewpoint with examples from a very wide range of organisms. Eighty-six papers were presented in this section; Sir Frederick Banting, Prof. C. H. Best, Prof. E. M. Walker and their respective collaborators presented work on varied endocrinological and related subjects, which included respiratory metabolism and poisons; salt secretion; the site of formation of the phosphates of blood serum; the phosphoric esters of normal and malignant tissues; the biological effects of sericite and various other mine dusts; and the respiratory metabolism of the seal. Prof. J. B. Collip and his collaborators presented work on endocrine interrelations during pregnancy; the influence of prolonged administration of an anterior pituitary extract on the ketosis of experimental diabetes; the production of endometrial moles through operation on the rat uterus during the second part of pregnancy; the nature of the constitutional factor in chronic atrophic rhinitis; and a number of other papers on the effects of various hormone extracts. Dr. J. S. L. Browne and E. M. Venning showed the effects of various treatments on normal and ovariectomised women. Prof. H. Wasteneys and his colleagues presented papers on factors affecting the rate of protein breakdown and on the synthetic action of pancreatic lipase, together with reports on new biochemical techniques. Prof. D. T. Fraser and colleagues gave an interesting

group of papers on sera and toxins. Prof. P. Masson spoke on "La multiplicité probable des syncytium de Schwann".

Papers of a general zoological or botanical nature numbered thirty-one. Prof. Marie-Victorin, J. Rousseau and J. Brunel gave the results of systematic studies of the Quebec flora. Prof. R. B. Thomson presented a new interpretation of the segmental organisation of *Osmunda* and Prof. H. S. Jackson described variations in the short-cycle rusts; with their colleagues and students they presented a series of other papers on plant anatomy and mycology. Dr. J. H. Craigie gave an exhaustive account of the epidemiology of wheat stem rust. Dr. J. W. McArthur presented data on tomatoes which are of great significance for general theories of the inheritance of quantative characters. Dr. L. O. Gaiser showed the occurrence of different chromosome numbers in various wild populations of *Liatris punctata*. Prof. A. H. R. Buller reviewed our knowledge of the sclerotia of the higher fungi. Prof. G. H. Scarth and J. Levitt described a method of measuring water permeability of freed plant protoplasts and gave new data on the problem of cell permeability in relation to hardiness.

A dinner in honour of Prof. Wilson Smith, professor of botany at McMaster University, who is retiring this year, and various field excursions were interesting features for this Section.

The social arrangements made by McMaster University and local residents, and the facilities for accommodation, exhibits and meetings provided by the splendid new buildings of the University were much appreciated.

Obituary

Prof. B. L. Robinson

FLORISTIC botany suffered a heavy loss by the death on July 27 of Benjamin Lincoln Robinson. Born at Bloomington, Illinois, on November 8, 1864, he graduated A.B. at Harvard in 1887, and then studied under de Bary at Strassburg, where he took the Ph.D. in 1889. His early work was anatomical, especially on unusual stem-anatomy; his thesis was on the stem-anatomy of *Phytocrene macrophylla*.

Returning to Harvard, Robinson became assistant in the Gray Herbarium under Sereno Watson, and on Watson's death in 1892 was appointed curator. The development of the Herbarium and the continuation of the taxonomic researches on American botany begun by Gray and continued by Watson have been Robinson's life-work. He found the Herbarium poorly housed, inadequately equipped, with a meagre endowment, and no definite status in the University. By the aid of generous donors he was able, during the years 1909–15, gradually to replace the little old building by an imposing modern structure which has been described as the safest and most conveniently arranged and best equipped herbarium building in the world. The endowment in 1899, by Mrs. Gray, of an Asa Gray professorship of systematic botany, of which Robinson was the first incumbent, added instruction to the functions of the Herbarium.

Two important pieces of work demanded attention when Robinson became curator—the completion of Gray's "Synoptical Flora of North America", and a much needed revision of Gray's "Manual of Botany". The former, with the aid of several experienced botanists, was completed in 1895–97, and the latter in conjunction with M. L. Fernald in 1908.

The results of Robinson's work and that of his assistants, on the floras of North America, Mexico and tropical South America, are embodied in a long series of papers in the *Proceedings of the American Academy of Arts and Sciences* and other periodicals. The substantial volumes of the reprints collected in the convenient form of "Contributions from the Gray Herbarium" are a monument to their industry. Robinson was specially fond of the Compositæ, and his "Revision of the genus *Brickellia*" was the first of the larger "Memoirs of the Gray Herbarium" begun in 1907.

Robinson's interest in local and regional botany found expression in the New England Botanical Club started in Boston in 1895, and for thirty years after its inception in 1899 he edited its journal, *Rhodora*. The Club collection lodged in the Gray Herbarium numbers more than 150,000 sheets.

British botanists showed their appreciation of Robinson's work by electing him to the foreign membership of the Linnean Society of London in 1922. His colleagues and friends at home and abroad will regret the passing of an eminently sane critical botanist and a courteous and kindly gentleman.

A. B. RENDLE.

WE regret to announce the following deaths:

Lieut.-Colonel H. W. Acton, C.I.E., formerly director of the School of Tropical Medicine, Calcutta, on August 23, aged fifty-two years.

Prof. Henry Briggs, O.B.E., Hood professor of mining in the University of Edinburgh since 1924, and professor of mining in Heriot-Watt College since 1919, on August 24, aged fifty-two years.

Prof. E. Jeanselme, emeritus professor in the faculty of medicine in the University of Paris, known for his work on syphilis, leprosy, and the history of medicine, aged seventy-seven years.

News and Views

Protection during Air Raids

THE recent air exercises at Portsmouth have shown once more that in some states of the weather it is impossible to prevent a hostile air fleet from launching an attack upon a city. It is essential, therefore, that we should do all we can to minimise the effects of air raids, if unfortunately it should be found impossible to prevent wars. The Government is preparing a series of six handbooks dealing with different aspects of the problem, and the first of these has recently been issued (Air Raid Precautions, Handbook No. 2. Anti-Gas Precautions and First Aid for Air Raid Casualties. Pp. 110. London: H.M. Stationery Office, 1935. 6*d*.). Mr. C. B. O. Mohr, 147 Milton Road, Cambridge, the secretary of the Cambridge Scientists' Anti-War Group, writes, however, to say that his Group considers that with the proposed protection casualties up to 30 per cent of urban populations are likely to occur. This Group is investigating the technical side of the problem, and he suggests that other scientific workers should do likewise and make their results known. These dangers can no longer be ignored, but on the other hand they should not be exaggerated. It is not only sensational journalists who have published misleading statements about new engines of war of extraordinary potency, but even statesmen in responsible positions who are in a position to obtain accurate information. One of these has said that scientific men "will turn to making a high explosive bomb about the size of a walnut and as powerful as a bomb of big dimensions". The actual fact is, however, that every endeavour has failed to produce an explosive appreciably more powerful than nitroglycerine, which was discovered by Sobrero in 1846. Equally exaggerated statements have been made about the effects of gas bombs; but high explosives, incendiary and gas projectiles are all very serious sources of danger and should be investigated authoritatively and impartially.

Academic Freedom

THE Conference on Academic Freedom held at Oxford on August 14–16 was arranged by the provisional committee formed last October following the censure passed on addresses by Mr. H. D. Dickinson, of the University of Leeds, and Prof. H. J. Laski, of the University of London. The Conference opened with a discussion on academic and professional freedom, over which Prof. J. L. Myres presided, and a standing committee was formed to give permanent character to the protest against any infringement of the rights of academic freedom. Mr. G. D. H. Cole pointed out that, although in Great Britain we are relatively immune from interference with academic and professional freedom, there is a serious danger of a rapid growth of intolerance, and this applies particularly to the professional worker in business or industry. What is wanted is not to prevent interference altogether but to keep it within the limits within which it is absolutely necessary. The difficulty arises over the exercise of the professional man's rights as a citizen and the rights he holds in common with other people in matters of personal conduct and behaviour. Bertrand Russell made a vigorous plea for freedom for teachers to express their opinions within as well as outside their professional activities, and for organised defence against victimisation.

AT the second session of the Conference, over which Prof. Lascelles Abercrombie presided, the question of international professional relief was discussed. Reports were read dealing with the persecution of teachers of all grades in Italy, Spain and Bulgaria as well as in Germany. Prof. Abercrombie said that internationalism must be identified with civilisation itself. A resolution was passed recognising the need of relief for persecuted teachers in other countries besides Germany, and establishing a committee to co-ordinate such work internationally. The final session of the Conference, over which Prof. Julian Huxley presided, dealt with the utilisation of science, and Prof. Huxley suggested that a long-range policy of the utilisation of science would involve the transformation of the economic and social system. Mr. J. L. Hodgson insisted that no creative work of value is ever done for money, and Dr. L. E. C. Hughes said that if science is to have a broadening humanitarian future and the scientific worker is to have a share of responsibility for his actions, it can only be in accordance with his own standards of scientific procedure and not with those arbitrarily imposed by non-scientific politicians. A resolution was passed to set up a committee of representatives of scientific and technical organisations to co-ordinate the activities of scientific associations and scientific workers in carrying out the pledge to secure that, so far as lay in their power, science should be used only for the benefit of humanity.

Artificial Radioactivity and Therapeutics

A NOTE in *The Times* of August 24 states that Prof. Ernest Lawrence, of the University of California, reports further progress in the production of artificial radioactivity. By subjecting ordinary salt to high-voltage X-rays, he claims to have produced in his laboratory minute amounts of radio-sodium, which emits radiation only of the γ-type, and has a half-life period of only about 15 *hours* as compared with the 1700 *years* of radium, while the suggestion is made that great therapeutic possibilities are thus opened up. The high reputation of Prof. Lawrence leaves us in no doubt as to the validity of his experimental claim; but it seems all the more necessary to suspend judgment about therapeutic possibilities until a vast

amount of experimental biological work has been carried out. It was suggested that it might be possible to inject the radio-sodium into the tissues, apparently with the view of obtaining its local action upon malignant growths. How the localisation is to be effected will, we think, be rather a problem. A further point is that the short half-life period is not necessarily by any means an advantage from the therapeutic point of view. One of the certain facts which have resulted from the scientific study of radiation therapy is that uniform and carefully adjusted dosage is essential to success. The new product—radio-sodium—produces a form of radiation which is rapidly diminishing in amount; constancy of radiation, therefore, cannot be expected. It is certainly by no means the case that an initial heavy dose of radiation which rapidly decreases will have the same biological effect as the same total dose provided by a smaller constant source acting for a longer time. From the physico-chemical point of view, Prof. Lawrence's work is of the deepest interest, but to mention therapeutic possibilities at this early stage seems to us decidedly premature.

Red Kafirs of Nuristan

IT is anticipated that further light will be thrown on the much-disputed origin of the Bashgali, or 'Red Kafirs' of Afghanistan, by recent investigations of their language and customs by Dr. George Morgenstierne, of the Goteborg High School, Sweden. In the meantime, *The Times* correspondent at Simla reports in the issue of August 17 that a German botanical expedition, which has worked its way through the Hindu Kush to the Chitral, has come into contact with the Red Kafirs among other strange tribes of Nuristan. The Red Kafirs—so-called to distinguish them from the Black Kafirs, whom some ethnologists regard as having negro affiliations—are sometimes credited with an origin which legend traces to Arabia, while on another view it has been suggested that they are descendants of the soldiers of Alexander. The most probable theory is that both racially and culturally they preserve a strain of the same stock as the Aryan invaders of India. Although they have been converted to Islam, they retain a number of pagan customs, in which some would see traces of ancient Greece. It is probable, however, that the resemblance is no more than generic, and that the strange customs reported of them are a debased survival of beliefs of the primitive Arya. Thus it is said that although they believe in one chief god, they also recognise forty or fifty other deities, to whom sacrifices are offered on high places, while the dead are placed in sacred groves. One of the most interesting features of their customs is a song and dance ritual in connexion with a central altar. Dead heroes are commemorated by wooden equestrian statues, which are sometimes accompanied by figures of an attendant and the hero's wives seated behind on chairs. The general character of these statues and their technique have been made the basis of a suggested connexion with the statues of Easter Island, and thought to point to one possible source of the 'Aryan' strain which some would see in Polynesia.

Restoration at Avebury

OPERATIONS for the exploration and restoration of the avenue leading from Overton Hill to Avebury, which were begun by Mr. Alexander Keiller last year, have been resumed. It is expected that all the surviving stones of the avenue will shortly have been placed in their original positions. The recent work has yielded information as to the original plan and method of construction additional to that obtained last year. Six stones, it is stated in a report in *The Times* of August 24, have been re-erected this year, including two of the largest megaliths known in the whole of the avenue, and the only two remaining stone-holes in the section have been identified; and at the time of writing two stones were still to receive attention. Of these, No. 9 is the only one which has never fallen. Advantage will be taken of the concreting, which will make it safe for future generations, to examine the method of packing followed when it was erected originally. The companion stone, No. 10, re-erected by Mrs. M. E. Cunnington in 1912, was shown by last year's examination to have been replaced some distance from its original position, as well as back to front and upside down. It will be placed in its correct position in its proper stone-hole, which has recently been discovered. In the next section, excavations are being undertaken on the sites of the stones between the north-western limits of last year's operations and the entrance to the circle. Here evidence has been found to show that at least two of the stone posts were broken up on the spot and without the use of fire. No. 39, partially uncovered in the laying of a pipe-line in 1913, and No. 40 have now been completely excavated, and will be re-erected shortly.

Further Discoveries at Colchester

LATER excavation of the remains of the remarkable wall discovered on the Romano-British site on Sheepen Farm at Colchester (see NATURE, August 17, p. 251) have served only to strengthen early impressions of its singular character. It has been found to run in an east-west direction for a distance of approximately 352 ft. At the eastern end, the possibility of further examination comes to an end at Sheepen Lane, so that it cannot be stated how far, if at all, it extended in this direction. At the western extremity, after a somewhat sinuous course, the wall turns in a right-angled bend to run northward, the construction continuing to be identical in form. The northern corner of what was evidently a large enclosure was located on this western side at a distance of 291 ft. from the southern turn. The course of the northern face is now being traced. Vestiges of cross walls, one running east and west, the other north and south, have been found at a point situated approximately 150 ft. east of the west wall. Of these, the former is the more substantial, its foundations having a breadth of 4 ft. 6 in., while those of the latter are only 2 ft. 6 in. wide. Further excavation showed these to be part of the walls of a Romano-Celtic temple, of which the enclosure was the *temenos*. The walls of the temple have now been completely traced (*The Times*, August 28).

Quetta Earthquake of May 31

WE have received from the Under Secretary of State for India an advance copy of a brief report on the Quetta earthquake. In the loss of human life, it ranks as one of the most destructive of all known Indian earthquakes. Its disturbed area was probably less than 300,000 square miles, while the Assam earthquake of 1897, the Kangra earthquake of 1905 and the North Bihar earthquake of 1934 were all felt over areas of between 1½ and 2 million square miles. The epicentral area is a band about 70 miles long and 15 miles wide, running from Quetta, through Mastung, to midway between Mastung and Kalat. One of the most striking features of the earthquake was its brief duration, which was probably less than half a minute. The intensity of the shock rapidly diminished from the central area, suggesting that the focus was perhaps not more than a mile or two below the surface. In the district between Peshawar and Karachi, the alignment of the mountain ranges is abruptly broken by a marked re-entrant angle running up through Sibi to Quetta. At the apex of this angle, the rocks must be in a condition of great strain, and it is possibly the sudden yielding of the rocks under this strain that causes the numerous earthquakes in this part of Baluchistan.

Circulation of the Earth's Atmosphere

AT the International Meteorological Conference at Utrecht in September 1923, a resolution was passed that arose from a proposal of the late Prof. Exner for the calculation of coefficients of correlation between weather anomalies in distant parts of the world. This resolution was to the effect that long and homogeneous series of observations of pressure, temperature and rainfall should be published with the view of furthering the study of the general circulation of the earth's atmosphere; that a small number of stations at a mutual distance of 500–1,000 kilometres should be included, preferably stations belonging to the Réseau Mondial (a network of stations for which annual summaries are published); and that this material for publication should be collected with the aid of various meteorological institutes, the long series being taken up to the year 1920. This resolution took shape in vol. 79 of the Smithsonian Miscellaneous Collections under the title "World Weather Records", to which has been added recently a supplementary volume with the same title covering the period 1921–30, but also including some summaries of long records that were not available in time for vol. 79. The new material occupies the whole of vol. No. 90 of the same series of Miscellaneous Collections, the cost of publication being met by a grant from Mr. John A. Roebling. It is scarcely necessary to point out the advantage to students of world weather of a collection of data of this kind, which gathers together in a compact form material that is often obtainable only at great trouble and expense. It can be used by those who carry out statistical studies with the view of establishing equations for long-period forecasting on the lines developed by Sir Gilbert Walker and others, and also for the study of periodicities, while the addition of monthly sunspot and solar radiation data makes it possible to add the study of solar-terrestrial relationships. The supplementary material includes the long Edinburgh series, which goes back to 1731 for temperature and to 1770 for precipitation.

Marine Research at Port Erin

THE main work at the Marine Biological Station, Port Erin, Isle of Man, has been on the rearing of oyster larvæ up to the time that they settle as spat. The report for 1934 (No. 47), drawn up by Dr. R. J. Daniel, shows that many other researches are being carried out, but the grant-in-aid from the Development Commission has made it possible to investigate the feeding of the oyster larvæ. The zooids from certain common seaweeds have been used, and by choosing a succession of different species, zooids of one kind or another are provided throughout the summer months when the oyster larvæ are present in the water. This special research occupies Mr. J. A. Bruce and Dr. Mary Parke. Detailed investigations on the morphology, cytology and life-cycles of the brown seaweeds have been necessary, with the testing of various culture media. The results have so far been of an encouraging nature, and it is hoped to expand the scope of the work in future. Samples of local herring are still continuously examined throughout the fishing season. Lobster culture is also progressing, lobsterlings and younger stages as well as more than 3,000,000 plaice eggs and larvæ from the pond having been liberated into the sea. The scheme for research also includes work on the conditions and relations of inter-tidal life on the beach. It is satisfactory to see that a large number of visitors, especially classes from schools, have worked at the Laboratory during the year.

Problems of Forestry

THE fifteenth number of *Sylva* (published by the Edinburgh University Forestry Society, 1934–35), the annual journal of the Edinburgh University Forestry Society, fully maintains the standard which this publication has achieved. Among the professional articles may be included "Impressions of British Forestry", in which some interesting criticisms are made by H. E. Marées, and a second on "The Forests of Denmark", by N. Bang. Forestry in the Empire is represented by articles on "Forest Research in Trinidad", in which C. Swabey treats of the considerable progress made in this direction in recent years; the "Problem of Forestry in Southern Rhodesia", an article recommended to those interested in that portion of the Empire. Afforestation on the Bauchi Plateau of Northern Nigeria, by J. Dundas, and preliminary notes for a working plan of woodbush forests in South Africa, by C. C. Stapleton, are also discussed. Allusion is also made to the visit paid to West Africa in 1934 by Prof. E. P. Stebbing, during which he saw something of the forests of a number of British and French Colonies, returning home via the Sahara.

Tropical Diseases Research in Puerto Rico

THE eighth annual report of the Director of the School of Tropical Medicine of the University of Puerto Rico (under the auspices of Columbia University), recently received, summarises the work of the School during the year ending June 1934. Seminars, lectures and clinics are held weekly in the School, and the Pan-American Medical Association visited the School in March. Much research work has been done, of which an outline is given. This includes a study of tuberculosis and its occurrence in the Island, and a skin test for *Brucella* infection has been developed. In the Department of Chemistry, work on vitamin A testing of Puerto Rican food plants has been completed. In parasitology, special methods for detecting ova of *Schistosoma mansoni* have been devised, and some cases of human infection with the liver-fluke, *Fasciola hepatica*, have been detected. In mycology, infection with new species of ringworm organisms has been found, and the disease known as granuloma inguinale has been investigated. A list of the papers that have been published from the School is appended, together with details of administration and finance.

Twenty-Five Years of Philosophy

IN recognition of the Royal Silver Jubilee, movements in British philosophy during the past twenty-five years have recently been reviewed in the *Philosopher* (**13**, No. 3, July 1935). In 1910, Bertrand Russell and A. N. Whitehead crystallised the logistic tradition and created the analytic method. The neo-realist creed has been developed by Russell, and the great principle of emergence has taken an important place in modern philosophy, chiefly through the work of C. Lloyd Morgan. These and other systems are, however, opposed by the concept of idealism, the greatest British supporter of which is F. H. Bradley. This reaction against materialism has received much support from British thinkers. Bradley supports absolute idealism, which is closely related to the philosophy of the Hegelians such as Sir James Baillie, Viscount Haldane, etc. Idealism has also found great favour among leading men of science like Sir Arthur Eddington and Sir James Jeans. The antagonism between spiritualism and materialism is exemplified in the controversies concerning animate Nature—vitalism and mechanism. L. T. Hogben supports the latter, but opposed to his views are those of Sir J. Arthur Thomson and J. S. Haldane, who claim the independence of biology from physics. The past twenty-five years has witnessed a welcome approach of philosophy, religion and the positive sciences.

Early Books on the Hyacinth

UNDER the title "The Voorhelms of Haarlem", Mr. W. Roberts gives an interesting account of some of the Dutch bulb growers, and their literary efforts, during the eighteenth century (*J. Roy. Hort. Soc.*, **60**, Part 3, pp. 199–208, May 1935). The Dutch trade in bulbs was established in the seventeenth century, upon a basis of secrecy. The "Dutch Gardener or the Complete Florist", a book by Henry Van Oosten, published in London in 1703, devoted four pages to the hyacinth and forty to the tulip, but gave away none of the precious information. The publication of "A Treatise on the Hyacinth" by George Voorhelm, in 1752, broke the tradition, and, far from ruining the Dutch trade in bulbs, laid the foundation for development to its present magnificent proportions. The volume was translated into English, French, Italian and German, though no Dutch edition was apparently needed. It was the first scientific treatise on bulb culture, but Mr. Roberts cites many more later volumes on the same subject, and also outlines, in pleasing style, the later development and fortunes of the house of Voorhelm.

Estimation of Small Percentages of Bismuth

IN view of the need for a generally agreed and reliable method of analysis for the small percentages of bismuth in copper, the Fiscal Policy Joint Committee, Brass, Copper and Nickel Silver Industries in 1933 enunciated, through a specially appointed Technical Sub-Committee, a number of analytical principles to be observed in the estimation. This has now been followed by a detailed method for the determination of quantities of bismuth of the order of 0·0002–0·005 per cent, based upon published literature on the subject, and the Secretary of the Committee, the address of which is Kings Court, 115 Colmore Row, Birmingham, invites comments from any who are interested.

Mining in South Australia

THE "Mining Review" of the Department of Mines of South Australia for the half-year ending June 30, 1934, shows that there has been considerable activity in gold mining, due, of course, to the increase in the value of the product. Thus the quantity of gold obtained in 1933 was slightly more than double that obtained in 1932, but its value was considerably more than double that obtained in the previous year, being in fact approximately in the proportion of 7 to 3. There is also included in the pamphlet a description of a motor-driven rotary drill which has been devised, owing to the difficulty of obtaining fuel and boiler water for the ordinary steam-driven rotary drill.

International Congress of Americanists

OWING to local difficulties, the twenty-sixth session of the International Congress of Americanists, which should have taken place in 1934, at Seville, was postponed; and at one time it was thought that no meeting would be possible before 1936. Arrangements, however, have been made for the Congress to open at Seville on October 12 next. A programme is being arranged by the Organising Committee, of which S. Gregorio Marañon, president of the Geographical Society, is chairman. The topics selected for discussion include the relations of the individual and the State in the early Spanish expeditions of discovery, conquest and colonisation; types of cities in Spanish America in the colonial period, and the functions of the Hispano-American municipality; social and juridical conditions of the Indians in the

Spanish colonial period: the critical study of the scientific work as regards geographical knowledge of Spanish America accomplished by the Supreme Council and the "Casa de Contratacion" of Seville; and fundamental problems in the archæology, ethnography and philology of pre-Columbian America. The subscription has been fixed at 25 pesetas. All communications relating to the Congress should be addressed to S. Jose Maria Torroya, General Secretary, calle del Leon, 21, Madrid.

An Active Sunspot

A RECENT feature of interest on the sun's disc has been a group of sunspots that appeared suddenly near the central meridian between August 19 and 20. Its growth is shown as follows, the unit of area being one millionth of the sun's hemisphere:

Date	U.T.	Area	
Aug. 19^d	8^h	0	Heliographic position: long. 356°; lat. 28° N.
20	8	250	
20	11	350	
21	8	700	
22	8	800	

On being observed with the Hale spectrohelioscope at the Royal Observatory, Greenwich, the group was obviously very active, especially about the following times: Aug. 20^d $13\frac{1}{2}^h$; Aug. 21^d $8\frac{1}{2}^h$ and $9\frac{1}{2}^h$–10^h; Aug. 22^d 9^h. During the time that the spots were under observation, there were also continuous minor changes, often too rapid to record in detail, but sometimes producing quite obvious changes in the configuration of the accompanying hydrogen flocculi in less than an hour. On August 21 a stream of relatively dark hydrogen continued for about two hours from $8\frac{1}{2}^h$ to descend with a radial velocity of 40–50 km./sec. behind the leader spot. About 10^h on the same day, after a portion of the flocculi had shown a sudden brightening, a narrow stream of dark hydrogen was shot upwards with a maximum velocity of 140 km./sec., but this faded in about 10 minutes. If this phenomenon had occurred at the edge of the sun, the profile aspect would doubtless have been an eruptive prominence rising to a considerable height.

The Sky in September

As an offset to the perceptibly shortening days, September provides in the latitude of the British Isles unexcelled night skies to those who search with binoculars or merely use their eyes. By the middle of the month at 21^h U.T. ($=22^h$ Summer Time), the great triangle formed by Vega, Deneb, and Altair is not far past culmination, whilst crossing the zenith obliquely to the meridian is the Milky Way—a brilliant sight when the moon does not interfere. Arcturus, nearing the north-west horizon, is balanced by Capella in the north-east, and after midnight the Pleiades, Aldebaran, and the head of Orion make the low eastern sky conspicuous. There are also other gems, such as the tiny constellation, Delphinus, the double star cluster in Perseus, and the well-known double star, β Cygni. The moon is full on September 12 at 12^h, and in this lunation becomes the 'harvest moon'. On September 7 it occults λ Sagittarii (magnitude 2·9), the disappearance of the star taking place in twilight at 19^h $29{\cdot}5^m$ and the reappearance at 20^h 35^m. Saturn is the only planet at all well placed for observation; in the middle of the month it transits about 23^h. The ring system appears about half-way open. On September 12^d 3^h, the planet is in conjunction with the moon. Venus is at inferior conjunction with the sun on September 8, when the planet passes 8° south of the sun's centre; a thin crescent may then be observed telescopically. The variability of Algol (β Persei) may be observed within about $1\frac{1}{2}$ hours before and after the following times: September 4^d $23{\cdot}6^h$, 7^d $20{\cdot}4^h$, 25^d $1{\cdot}3^h$, 27^d $22{\cdot}1^h$ and 30^d $18{\cdot}9^h$. The sun enters the sign Libra (Autumnal Equinox) on September 24^d 0^h.

Announcements

DR. MARSHALL A. HOWE has been appointed director of the New York Botanical Garden as from October 1, in succession to Dr. E. D. Merrill, who has been appointed head of the Botanical Department, Harvard University. Dr. Howe has been assistant director of the Gardens since 1923. He has made several field excursions, especially to Newfoundland and the West Indies, and is an authority on the Hepaticæ and marine Algæ of North America.

THE second International Speech Congress will be held in Brussels on September 6–8, under the presidency of Mlle. Hélène Vacaresco, permanent delegate of Roumania at the League of Nations. The subjects for discussion will be instruction in speech, results obtained by the former congress, international exchange of lectures, and French as a universal language. The fee is 20 francs. Further information can be obtained from L'Agence Joseph Dumoulin, 77–79 Boulevard Adolphe Max, Brussels.

A BOOK by Dr. F. W. Lanchester on "Relativity" will be published by Messrs. Constable and Co., Ltd., on September 5. It presents the theory of relativity and the relationships of space, time and gravitation, in language suited to those who, though not highly specialised in mathematics, wish to grasp the meaning of four-dimensional space-time.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant vocational guidance officer to the Kent Education Committee—The Director of Education, Springfield, Maidstone (Sept. 7).

An assistant agricultural organiser to the Notts Education Committee—The Director of Education, Shire Hall, Nottingham (Sept. 11).

A mechanical engineer to the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, London, S.W.1 (Sept. 14).

An assistant librarian in the University of Aberdeen—The Secretary (Sept. 30).

A research fellow, two junior research assistants, and three junior laboratory assistants to the Wool Industries Research Association—The Secretary, Torridon, Headingley, Leeds, 6.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 341.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Attempts to Produce Helium 3 in Quantity

WITH reference to the results published by Harnwell, Smyth and Urry[1] in which there is an apparent production of helium of atomic weight 3 in considerable quantities (10^{-5} c.c.) in a discharge run in heavy hydrogen, we should like to mention some experiments which we have made during the past year on similar lines. Our apparatus resembles that used by Rutherford and Oliphant[2], a beam of positive rays being directed on to a target containing heavy hydrogen, the positive rays being produced by an auxiliary discharge in heavy hydrogen gas. The voltage applied to the rays was about 150 k.v., the auxiliary discharge carried about 8 milliamp. and the current in the beam was of the order of 100 microamp., but probably only a small proportion of this consisted of ions of heavy hydrogen.

After running for one hour, the gas was pumped into a glass reservoir which was then sealed off and the gas analysed by the micro-method of Paneth and Peters. A number of such bombardments were made and in all cases the hydrogen contained helium and neon, the ratio of helium to neon being greater than that in ordinary air. We consider that this gas was derived from the walls of the glass cylinder used for the discharge, and that the enhanced proportion of helium is due to the fact that any glass in contact with air adsorbs and dissolves helium in preference to neon[3]. The release of this helium is facilitated by the presence of hydrogen.

Our reasons for preferring this explanation are two. First, the yield of neutrons, which should accompany the production of helium 3, was measured and found to be only equivalent at best to a source of 60 millicuries of (radon + beryllium); the helium corresponding to this yield of neutrons would not exceed 10^{-10} c.c. in the hour, while $10^{-8} - 10^{-7}$ c.c. of helium were commonly observed. Secondly, interferometric analysis of the helium spectral lines carried out by Mr. C. V. Jackson showed no sign of any extra doubling of the lines such as might be expected if any considerable proportion of the helium had a mass of only 3. For this analysis the helium + neon samples from five bombardments were united; the mixture consisted of about 1×10^{-7} c.c. neon and $3{\cdot}6 \times 10^{-7}$ c.c. helium, of which at least 90 per cent was ordinary helium of mass 4. It would not have been possible to detect less than 10 per cent of helium of mass 3 on account of the difficulty of photographing fringes with so small a quantity of gas.

A short recent communication by Smyth, Harnwell Bleakney and Lozier[4] appears to throw doubts on the interpretation of the evidence from the mass-spectrograph described in the earlier paper. They state, however, that their spectroscopic evidence for the production of helium remains entirely unexplained. We venture to suggest that their results may be explained in the same way as the very similar ones which we have obtained.

F. A. PANETH.
G. P. THOMSON.
Imperial College of Science and Technology,
London, S.W.7.

[1] G. P. Harnwell, H. D. Smyth and Wm. D. Urry, *Phys. Rev.*, **46**, 437; 1934.
[2] M. L. Oliphant, P. Harteck and Lord Rutherford, *Proc., Roy. Soc.*, A, **144**, 692; 1934.
[3] F. Paneth and K. Peters, *Z. phys. Chem.*, B, 1, 253; 1928.
[4] H. D. Smyth, G. P. Harnwell, W. Bleakney and W. W. Lozier, *Phys. Rev.*, **47**, 800; 1935.

Radioactivity of Potassium

SEVERAL hypotheses have been put forward[1] to explain the extremely long life-period of potassium, which conflicts with the theories of β-decay as well as with Sargent's empirical rule. Klemperer[2], however, has shown by an investigation in detail that none of the processes suggested really exists. He concludes from his experiments that an unknown, relatively rare isotope, ${}_{19}K^{40}$, is responsible for the β-activity of potassium, and similarly an unknown isotope ${}_{37}Rb^{86}$ in the case of rubidium.

On general principles, it can be said that β-decay will be possible, if the difference in the energies of the initial and final nucleus, ΔE, fits the relation:

$$(1) \qquad \Delta E > (m + m').c^2,$$

where m, m' are the masses of the two particles involved in the process. Hence, in the case of ${}_{19}K^{40}$, one would expect both positive and negative electrons leaving the nucleus, due to the processes

$$(2) \quad {}_{19}K^{40} \rightarrow {}_{20}Ca^{40} + e^- \text{ or } (2a)\ {}_{19}K^{40} \rightarrow {}_{18}A^{40} + e^+.$$

Both ${}_{20}Ca^{40}$ and ${}_{18}A^{40}$ are well-known, stable nuclei; and ${}_{18}A^{40}$ is relatively the most frequent isotope of argon. This means that the binding energy of the nucleus ${}_{18}A^{40}$ must be sufficiently low, and the relation (1) would scarcely be violated for the process (2a), if it is valid for the process (2).

Experiments hitherto have not shown any proof of an emission of positrons from potassium. I have also tested the radiation of potassium in a cloud-chamber, without finding any track of positively-charged particles. My experiments will be continued, and the results published in the *Zeitschrift für Physik*, but it does not seem to be very probable that any β+-emission will be found.

On the other hand, a simple β-decay of ${}_{19}K^{41}$ cannot be expected. The final product of this process, ${}_{20}Ca^{41}$, does not accord with our general knowledge of the system of stable isotopes[3]. Besides, the decay constant for this process would be lowered by a factor

of about 100 compared with the decay process of the rare isotope $_{19}K^{40}$, and the disagreement would be still more emphasised. We know further that an isotope $_{19}K^{42}$ cannot be responsible for the natural β-activity of potassium, for this isotope was produced artificially by Hevesy[4] and its half-period found to be about 16 hours. Therefore one comes to the conclusion that another relatively rare isotope of potassium exists, which is the source of the β-particles. This can only be $_{19}K^{43}$, which is transformed by the decay process to the well-known isotope $_{20}Ca^{43}$. This seems to be the only assumption not in conflict with all the available experimental evidence.

K. SITTE.

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Prague.
July 18.

[1] G. Gamow, NATURE, 133, 869; 1934. G. Beck and K. Sitte, NATURE, 133, 722; 1934.
[2] O. Klemperer, *Proc. Roy. Soc.*, A, 145, 638; 1935.
[3] J. Mattauch, *Z. Phys.*, 91, 361; 1934. K. Sitte, *ibid.*, in print.
[4] G. Hevesy, NATURE, 135, 96; 1935.

Spectroscopy of an Enzyme Reaction

IF a suitable amount of monoethyl-hydrogen peroxide is added to an active preparation of liver catalase at *p*H 7, the enzyme spectrum disappears instantly, and two new absorption bands in the green range of the spectrum appear. In the course of a few minutes, at room temperature, the new absorption bands decrease in intensity, and simultaneously the original enzyme spectrum reappears. When the change is complete, the cycle may be repeated by the addition of fresh substrate. The time required for the reaction cycle at 4° is four times that required at 24°. The reappearance of the enzyme spectrum is accompanied by the disappearance of the titratable peroxide oxygen from the system. No gas is evolved in this reaction. Acetaldehyde and ethyl alcohol are among the most probable reaction products.

The spectrum of the intermediate compound is to be attributed to a combination of the enzyme with the substrate. The alternative explanation that one is dealing here with the reduced (ferrous-) form of catalase can be discarded because neither molecular oxygen nor ferricyanide reoxidise it to the original ferric form, and because it does not combine with carbon monoxide.

Enzyme spectrum (after K. Zeile[1]):

I. 650 . . $\underbrace{646–620}_{629}$ . . . 610; II. $\underbrace{550–530}_{540}$ . . . 520 . . .

$\underbrace{510–490}_{500}$ mμ.

Spectrum of the enzyme-substrate compound:

I. $\underbrace{576–564}_{570}$, II. $\underbrace{540–529}_{534·5}$ mμ.

5×10^5 molecules of the substituted peroxide per enzyme molecule are required to complete the transformation into the intermediate compound. It is interesting to note that according to J. B. S. Haldane's calculations[2], based on Zeile's and Euler's data, $1·9 \times 10^5$ molecules of hydrogen peroxide are destroyed by one molecule of liver catalase per second under optimal conditions. This coincidence is still more striking since the enzyme is at least 5,000 times more active towards hydrogen peroxide than towards ethyl-hydrogen peroxide.

With hydrogen peroxide as a substrate, no apparent change of the enzyme spectrum is observed. The inference is, that since the rate of formation and the stoichiometry of the two enzyme-substrate complexes seem to be similar, the different catalytic efficiency towards the two substrates is due to the different velocity constants of the breakdown of the intermediate compounds.

A non-enzymatic model of the present observation is found in the reaction of methæmoglobin with hydrogen peroxide (Kobert[3], Haurowitz[4]) and with monoethyl-hydrogen peroxide. Here the intermediate compounds are similar to that observed above, so far as the absorption spectrum is concerned. But one molecule of methæmoglobin will only break up $3·6 \times 10^{-2}$ molecules of hydrogen peroxide per second (cf. K. G. Stern[5]), and an excess of only 20 molecules of hydrogen peroxide (Haurowitz, l.c.) and of 8 molecules of monoethyl-hydrogen peroxide will suffice to transform completely the spectrum of this catalyst into that of the intermediate compounds.

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Aug. 14.

[1] K. Zeile and H. Hellstroem, *Z. physiol. Chem.*, 192, 171, 1930.
[2] J. B. S. Haldane, *Proc. Roy. Soc.*, B, 108, 559; 1931.
[3] Kobert, *Pflüger's Archiv*, 82, 603; 1900.
[4] F. Haurowitz, *Z. physiol. Chem.*, 232, 159; 1935.
[5] K. G. Stern, *ibid.*, 215, 35; 1933.

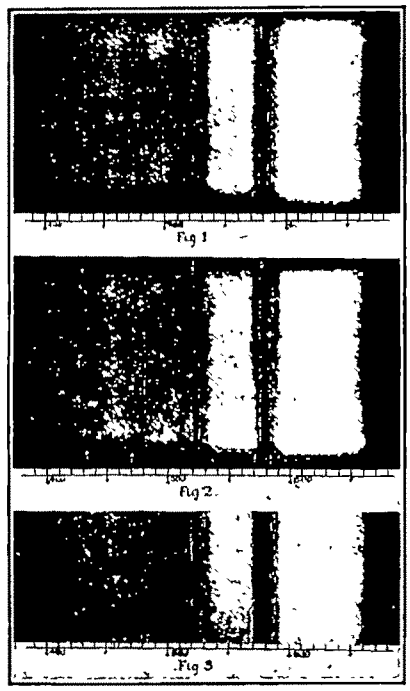
Pleochroism of Crystals of Rare-Earth Salts as Evidence of the Non-Rotation of Certain Electronic Orbits

So long ago as 1888, H. Becquerel[1] recorded that the absorption spectrum afforded by crystals of 'didymium' salts was different for different vibration planes of the incident light. Later, M. H. Dufet[2] made a detailed study of the crystallographic and optical properties of neodymium, praseodymium and samarium sulphates, in the course of which he confirmed and extended Becquerel's observations by recording the wave-lengths of bands in the absorption spectra of these salts for light vibrating parallel to the acute bisectrix, obtuse bisectrix and optic binormal respectively. He found that the intensity of individual absorption bands was often, though not invariably, different for the three principal vibration planes, even to the extent of their being absent from one of them.

In the course of a study of the relationship between the optical properties and chemical constitution of certain absorbing crystals by means of a grating microspectrograph used in conjunction with a polarising microscope[3], I have had occasion to examine the absorption spectra for various vibration directions in crystals of neodymium, praseodymium and samarium sulphates, and in ceric ammonium sulphate. The method adopted was to project a conoscopic ('directions') image of the crystal on the slit of the microspectrograph by means of a Bertrand lens, using a polariser but no analyser, and ensuring that the slit and the vibration plane of the polariser were parallel to a principal vibration plane of the crystal. An oil-immersion objective of $N.A. = 1·30$, in conjunction with an oil-immersion condenser, was used.

In this way it was possible to obtain absorption spectra which showed the effect of varying the ray

direction on the absorption bands. The results now obtained are exemplified by the absorption spectra here reproduced of crystals of neodymium sulphate. In Fig. 1 the slit and plane of vibration are parallel to the plane of the optic axes. In Fig. 2 they are perpendicular to this plane. By way of comparison the absorption spectrum of an aqueous solution of the salt is given in Fig. 3. The relations between



FIGS 1-3.

the ordinates of Figs. 1 and 2 and the ray direction are shown in stereographic projection in Figs. 4 and 5 respectively, in which the plane of vibration is parallel to the slit.

Fig. 1 shows that there is no marked change in the absorption spectrum on passing from vibration directions parallel to Z to those about half way between Z and X, but Fig. 2 shows that some

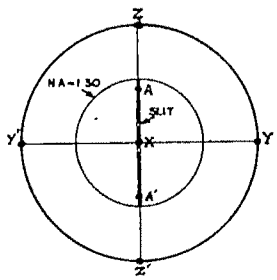


FIG 4.

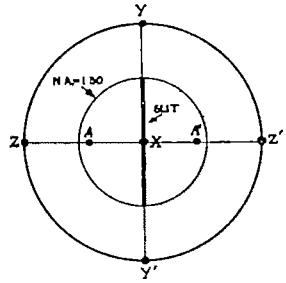


FIG. 5.

absorption bands show marked change on passing from vibration directions parallel to Y to those intermediate between Y and X. What is particularly important is that the bands fade out at different points, and that the directions for minimum absorption do not correspond with an axis of the Fresnel wave surface. In all, eleven crystals of neodymium sulphate were examined, but they all gave the same result. The positions of the bands agree, for the principal optical planes with those recorded by Dufet, with the exception that the present spectrograms do not show the bands from 622·5 to 638·0 mμ which he has described. Praseodymium sulphate behaved in an exactly analogous manner. A discussion of this, and of the results obtained with other absorbing crystals, will be published later.

It has been shown that the absorption bands of rare-earth salts are due to the incomplete N shell of electrons ($4F$ orbits), and as the present work shows that light of certain wave-lengths is not absorbed when its plane of vibration is in certain specific directions, it seems reasonable to assume that the orbits of at least some of the N electrons are fixed in relation to the crystal structure. As these are not valency electrons, it is probable that the metal ions as a whole are not capable of free rotation in the crystals examined.

I am indebted to Sir William Pope for a gift of rare-earth salts, and to Prof. J. R. Partington for the interest he has taken in this work.

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July 15.

[1] H. Becquerel, *Ann. Chim. et Phys*, VI, 14, 208; 1888.
[2] M. H. Dufet, *Bull. Soc. franc. Mineralogie*, 24, 373; 1901.
[3] E. E. Jelley, *Phot. J.*, 74, 514; 1934.

Diamagnetism of Thallium Single Crystals

WHILE several investigators have determined the susceptibilities of polycrystalline metals, measurements on single crystals have been rather few[1]. Bismuth crystals have been prepared and studied with great care by Focke[2], while single crystals of a few other metals like zinc, tin and antimony have been examined by McLennan and his collaborators[3]. We have recently succeeded in making measurements of the diamagnetism of single crystals of some metals; and the results obtained with thallium are of particular interest.

Single crystals of this element were prepared by the method of slow cooling in a manner similar to that of McLennan[3]. They were investigated with a magnetic balance specially devised for the purpose, wherein the Gouy force on the cylindrical specimen was compensated electrodynamically. Measurements could be made rapidly and to within 0·5 per cent at laboratory temperatures.

It is well known that thallium crystallises in the close packed hexagonal system, the ratio c/a being 1·62. As the crystal is heated, it passes into the cubical system at 235° C. Our experiments show that, at the laboratory temperature (30° C.), the diamagnetic susceptibility parallel to the hexagonal axis ($\chi_{\parallel}$) is 0·407 (all values of χ are given in 10^{-6} units) and the value perpendicular to it ($\chi_{\perp}$) is 0·163. This gives a magnetic anisotropy of 2·50, which is larger than the corresponding values of other similar metals. The average value for polycrystalline thallium works out at 0·244, which is almost identical with Honda's value[1] of 0·24.

On heating the crystal, we find that the susceptibilities in the two directions remain constant up to 235° C. At this temperature, the mean value decreases suddenly to 0·170 and remains the same for all orientations of the crystal in the magnetic field. It is interesting to observe that while $\chi_{\perp}$ remains nearly the same, it is the susceptibility

value in the other direction that shows a large fall, indicating probably that the movements of atoms when the close packed hexagonal type is changed into the face-centred cubical type are predominantly in this direction. On melting the crystal at 302° C., the diamagnetic susceptibility shows a still further decrease, reaching a value of 0·153 in the liquid state.

The chemical properties of thallium indicate that it is both trivalent and monovalent. The hexagonal structure is obviously due to the three valency electrons (6*s* and 6*p*) operating in the crystal binding, while in the cubic structure, only the single valency electron (6*p*) is active. It is surprising that in both cases the metal is diamagnetic and the diamagnetic susceptibility is independent of temperature in the temperature ranges concerned.

The plausible explanation seems to be that in the hexagonal structure, the electron binding is partly homopolar and partly metallic; while only the latter type of binding is prevalent in the cubical structure.

It is interesting to note that, while the atomic diamagnetic susceptibility of thallium is 34·75 according to these measurements, the susceptibility of the monovalent thallium ion (Tl^{+1}) is 38·75, after Kido[4]. This would lead to the conclusion that the single valency electron contributes a paramagnetic susceptibility of + 4 per gram atom, a value which is of the same order as those obtained for copper, silver and gold[5].

Experiments with single crystals of other metals are in progress and the results will be published shortly elsewhere.

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Annamalai University,
S. India. June 12.

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[2] *Phys Rev*, **36**, 319 · 1930.
[3] *Proc Roy. Soc*, *A*, **121**, 9, 1928, *Trans. Roy Soc Canada*, **23**, 159, 1929
[4] *Sci. Rep. Tôhoku Univ*, **22**, 835; 1933.
[5] Ref. 1, p 511.

Measurement of the Elastic Constant of Isotropic Transparent Solids

ULTRA-SONIC waves in liquids or transparent solids may be demonstrated visually by a method developed by the author and his co-workers[1]. Ultra-sonic waves produce a regular (sinuous) distribution of density, which gives optically an effect similar to a large number of cylindrical lenses. A parallel beam of light passing normal to the direction of the ultra-sound converges therefore to a system of focal lines. The distance of two succeeding lines produced by stationary waves is equal to half an ultra-sonic wave-length; in the case of progressive waves, which must be observed by means of a high-frequency stroboscope, the distance equals one wave-length.

By measuring the distance of a great number of focal lines it has been possible to obtain the values of ultra-sonic velocities in liquids with very high precision[1]. Measuring ultra-sonic velocity in glass, I have sometimes used polarised light. On one occasion, K. H. Hoesch and I made an unexpected observation. If the electric vector of the polarised light entering an oscillating cube of glass was normal to the front of the ultra-sonic waves, we observed by means of a second nicol—crossed to the polariser—a system of lines similar to that observed in natural light; or in polarised light the electric vector of which had an angle of about 45° with the wave front, but with smaller separation. As the system of narrow lines could not be observed in natural light, I concluded that it could not have been produced by a longitudinal wave, but only by a transverse wave. That the nodal lines of the transverse wave may be seen by means of two crossed nicols is due to double refraction in the position of maximal elastic strain, just as in an old experiment by Tyndall.

Measurements of the higher harmonics of a longitudinally oscillating piezo-electric quartz crystal have proved that the higher harmonics have no anharmonic deviations between each other, but a pronounced deviation from the fundamental. This seems to indicate that the velocity of longitudinal waves tends towards a limit. As the wave-length for the high harmonics is small compared to the thickness of the quartz, it is natural to assume that this limit is given by the velocity in the medium extending indefinitely in all directions. I therefore assumed (1) that the narrow lines observed were produced by transverse waves in the glass, the other lines by compressional waves; and (2) that for both waves the formulæ for the velocity in a homogeneous isotropic medium extending indefinitely in all directions would be valid with a very good approximation, because the wave-length was very small compared to the thickness of the glass.

This hypothesis made it possible to calculate the elastic constants of the glass from the measurements of the separations of the observed lines and the frequency of the oscillations. At the high frequencies used—for example, 4,894 k.c.—one gets the adiabatic elastic constants, which are slightly higher than the isothermal. For glass which had an isothermal Young's modulus of 7,471 kgm. mm.$^{-2}$, the adiabatic modulus was found to be 7,531 kgm. mm.$^{-2}$. The agreement is too good to be accidental. Poisson's ratio was 0·2072 and the modulus of rigidity = 3,119 kgm. mm.$^{-2}$. Measurements on cubes and bars of other kinds of glass have also given very satisfactory results.

The values given above are only the results of preliminary measurements; their precision is therefore not much better than 1 per cent. It is possible, however, to get a precision of better than 1 in 1,000; Poisson's ratio may even be measured to about 1 in 10,000, a precision never obtained before.

The method is now being applied to the study of high-frequency oscillations of cubes and bars of glass, and an account of the investigation will be given elsewhere.

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July 25.

[1] Ch Bachem, E. Hiedemann and H R Asbach, NATURE, **133**, 176; 1934 Ch Bachem und E Hiedemann, *Z. Phys*, **94**, 68; 1935. E Hiedemann und K. H. Hoesch, *Naturwiss.*, **23**, 511; 1935. Also other papers in *Z. Phys.*
[2] E. Hiedemann, H. R. Asbach und K. H. Hoesch, *Z. Phys.*, **90**, 322, 1934 L. Bergmann, *Ann Physik*, **21**, 553; 1935.

A New Wave Characteristic of Deep-focus Earthquakes

A PROMINENT phase appearing a few minutes after *ScS* on the seismograms at the Dominion Observatory, Wellington, of seven deep-focus earthquakes in the south-west Pacific, has been identified as a transverse wave reaching the station after having been reflected, first at the earth's surface near the epicentre, and then at the boundary of the core.

The designation of such a phase in accordance with current nomenclature would be *sScS*. This phase does not appear to have been recorded on any previous occasions. It is similar in character to *ScS*, and both are remarkably prominent on some of the seismograms.

The time-interval (*sScS–ScS*) provides a comparatively accurate method for determining the focal depths of abnormally deep earthquakes from a single seismogram at short epicentral distances: the interval being practically independent of epicentral distance.

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The Oblong Sunfish (*Ranzania*) in the Indian Ocean

DR. E. W. GUDGER, of the American Museum of Natural History, recently referred in NATURE (April 6, 1935, p. 548) to the occurrence of *Ranzania* in the Indian Ocean, his only record being based on an original painting from Mauritius by Nicholas Pike.

The Australian Museum possesses two specimens of the oblong sunfish from the Indian Ocean: (1) a small example from Mauritius, of which I have published a sketch[1], and (2) a larger specimen from near Albany, Western Australia, whence the species had been recorded by McCulloch in 1910. Other records of this fish have been tabulated by me[2] in an account of its synonymy.

Apart from the few recorded specimens from Mauritius and Western Australia, there are few references to this fish in the Indian Ocean region. Thus Pennant in 1798 listed "*Balistes truncatus*" from Ceylon and this, like the sunfish in Day's Supplement to his "Fishes of India", may have been a *Ranzania*. Also in 1798, Lacépède described a *Ranzania* from a drawing by Commerson, who probably painted it in Mauritius. Dr. J. Pearson published a note and a photograph of a sunfish (Pearson, *Spolia Zeylanica*, **7**, 208 and fig.; 1911) from near Jaffna, Ceylon, which is easily recognisable as a *Ranzania*.

Dr. Gudger has requested me to direct attention to these records, bibliographical references to which will be found in the papers quoted.

GILBERT P. WHITLEY.

Australian Museum,
Sydney. June 14.

[1] Whitley, G. P., "Sunfishes", *Victorian Naturalist*, **49**, 207–213, fig. 6; 1933.
[2] Whitley, G. P., "Studies in Ichthyology, No. 7," *Rec Australian Mus.*, **19**, 108–111; 1933.

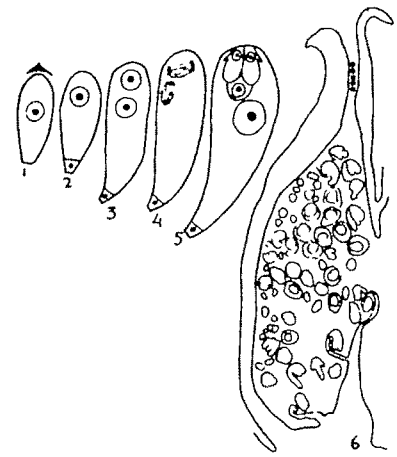
Life-History of *Butomopsis lanceolata*, Kunth.

MEMBERS of the family *Butomaceae* have received little attention, although several genera and species of the closely allied family *Alismaceae* have been thoroughly worked out. Recently I had an opportunity of investigating the life-history of *Butomopsis lanceolata*, material of which was kindly supplied to me by Mr. A. C. Joshi of Benares.

The development of the male gametophyte follows the normal course. There are two definite male cells and a tube nucleus in the mature pollen grain.

The development of the female gametophyte presents some interesting and unusual features. The hypodermal megaspore mother-cell divides to form a small ephemeral cell at the top and a larger cell below, which develops into the embryo-sac (Fig. 1). Of the two nuclei resulting from the first division, the primary chalazal nucleus is very small, and may sometimes be cut off by a wall (Fig. 2). It degenerates very early and may be said to represent the single antipodal cell the remains of which can be seen up to the time of fertilisation. The primary micropylar nucleus divides twice and produces four nuclei, three of which organise into a normal egg-apparatus and the fourth is the upper polar nucleus (Figs. 3–5); the lower polar is missing.

Double fertilisation occurs. The endosperm is of the Helobiales type, as also reported for *Echinodorus macrophyllus* by Dahlgren[1]. Sometimes supernumerary bodies resembling the sperm nuclei have also been seen in the pollen tube. These are similar to the X-bodies described by Artschwager[2] for the sugar beet.



FIGS. 1–5. Schematic representation of the development of the embryo-sac of *B lanceolata*. FIG. 6, longitudinal section of the ovary, showing pollen grains in the stylar canal.

A very striking phenomenon was observed in connexion with pollination. Usually the pollen grains germinate on the stigma, but in some favourable preparations a few were found *inside the hollow stylar canal* (Fig. 6), *and even inside the ovary*. In one case a pollen grain had germinated and sent out a small pollen tube.

I am not aware if a parallel case has been reported for any other angiosperm, and would be grateful to other botanists for directing my attention to the relevant literature on this subject.

I am deeply indebted to Dr. P. Maheshwari for his kind help and valuable suggestions.

B. M. JOHRI.

Department of Botany,
Agra College, Agra.
July 18.

[1] Dahlgren, K. V. O., "Die Embryosackentwicklung von *Echinodorus macrophyllus* und *Sagittaria sagittifolia*", *Planta*, **21**, 602–612; 1934.
[2] Artschwager, E., and Starrett, R. C., "The Time Factor in Fertilisation and Embryo Development in the Sugar Beet", *J. Agric. Res.*, **47**, 832–43; 1933.

Functions of the Corpus Allatum of Insects

IT was suggested recently[1] that the active substance (moulting hormone) which initiates cell division in the epidermis of *Rhodnius* and so induces moulting, and the substance (inhibitory hormone) which restrains 'metamorphosis' until this insect is full-grown, are both secreted by the corpus allatum. By transplanting the corpus allatum from a younger

insect (4th instar) into an older one (5th instar), which then develops into a nymph instead of an adult, it has since been proved that the absence of metamorphosis in the young stages is certainly dependent on the secretion of this gland; though it is still uncertain whether there are really two hormones or only a single one in different concentrations. Further, both moulting and inhibitory effects are non-specific: both can be produced in *Rhodnius* by appropriate secretions from bugs of the allied genus *Triatoma*.

The corpus allatum remains active in the adult *Rhodnius*; this suggests that in this stage it is concerned in the regulation of reproduction. This has been proved to be the case. Adult females deprived of the brain and corpus allatum do not develop eggs; but if the brain is removed without the corpus allatum, eggs are developed normally; and the blood from females *with* a corpus allatum will induce egg development in females *without*. This effect, also, is non-specific.

The moulting hormone will not induce egg-formation; nor will the egg-forming hormone induce moulting. This little gland therefore secretes at least two and possibly three hormones regulating growth. It has already been suggested that diapause in insects may be due to a temporary failure of its secretion[1]; perhaps the so-called 'gonotrophic dissociation' (the failure to develop eggs after feeding), which occurs in the females of certain mosquitoes during hibernation, is due to the same cause. This question is being investigated.

V. B. WIGGLESWORTH.

London School of Hgyiene
and Tropical Medicine.
Aug. 3.

[1] V. B. Wigglesworth, *Quart. J. Micr. Sci.*, 77, 191; 1934.

Plankton Production and the Nitrate Nitrogen and Phosphate Cycles in the Pacific Ocean off New South Wales

RECENT quantitative research into the production of plankton and more especially into the seasonal cycle of plankton production has been accompanied by a keen appreciation of more accurate chemical analyses of sea-water. Whilst the complexity of the interrelationships between the biological and the physico-chemical conditions in the sea are being thoroughly realised, some rather definite and interesting correlations have been already demonstrated, and the investigation of the different seas in different latitudes promises further light on this subject.

One of the most interesting of these correlations is the marked cycle in the amount of nitrate nitrogen and phosphate in European seas, which seems closely bound up with the cycle of plankton production. Thus Harvey and Atkins working at Plymouth have shown how the nitrate nitrogen and phosphate are reduced almost to zero in the surface waters of the English Channel during the summer months, the fall beginning after the attainment of a maximum in the growth of diatoms during the spring.

During the past four years, a continuous series of plankton and physico-chemical determinations have been made by us in the Pacific Ocean off the New South Wales coast on the open continental shelf. The results indicate that whilst there is not such a marked cycle as in the English Channel (our sea temperatures are much higher, ranging from approximately 16° C. to 22·5° C.) there are definite occasions in the year when the nitrate nitrogen in particular and the phosphate to a slightly lesser extent are reduced to a mere trace in the surface waters, or even to zero. These occasions always occur after the attainment of a spring maximum in diatom production. The summer is a period with a low concentration of nitrate nitrogen, but the phosphate concentration typical of these seas is quickly regenerated. The winter concentration of phosphate in our surface waters ranges from 20 mgm. to 30 mgm. P_2O_5 per cubic metre, whilst the nitrate nitrogen ranges from 20 mgm. to 35 mgm. per cubic metre.

These are probably the first records from the southern hemisphere of a cycle resembling that of European seas, the only other seasonal records being those from the Antarctic with their own peculiarities.

Full details have been drawn up for publication in the *Journal of the Linnean Society of New South Wales*.

WILLIAM J. DAKIN.
ALLEN N. COLEFAX.

Department of Zoology,
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July 24.

Ventilation and Domestic Heating

THE "Writer of the Note" on this subject[1] refers to experiments carried out by the Department of Scientific and Industrial Research and the Medical Research Council, and adds that "No evidence was obtained that any difference on 'nose opening' is due to the temperature of the source, either bright or dull". These experiments were carried out by Messrs. Dufton and Bedford, who received grants from the above bodies, which as customary allowed their grantees to publish their researches on their responsibility and not on that of the Department or Council.

I myself have received a grant from the Medical Research Council to aid me in research which negatives the conclusions of Dufton and Bedford.

The correctness of my conclusions about 'nose opening' rays has been confirmed not only by myself, but also by Dr. W. A. R. Thomson, who carried out observations on 100 sailors at H.M.S. *Excellent*, and by Dr. Dishoeck of the Rhinological Department, Groningen University. The latter has used an exact method of experiment, and has pointed out the cause of the failure of Dufton and Bedford to confirm my work.

Dr. Dishoeck's paper was published in the June number of the *Journal of Industrial Hygiene*. In the *Lancet*, July 13, 1935, I published the latest of my papers on the subject, and described therein a method of measuring the air-way of the nose, which should prove of general use to rhinologists. There is no doubt of the susceptibility of certain people—not all, but about 50 per cent—to 'nose opening' rays or of the importance to comfort of the quality of the rays imparted by sources of heat.

LEONARD HILL.

[1] NATURE, 136, 225, Aug. 10, 1935.

I HAVE read with interest Sir Leonard Hill's letter and his paper on "A Method of Measuring the Air-way of the Nose" which appeared in the *Lancet* of

July 13. As the subject is of practical importance, I am sorry that experts do not seem to be in agreement as to its extent or as to its effect on the general health of the half of the community which is said to be affected by it. Considerable use by those commercially interested in domestic heating has been made of expert assertions on the subject, and these are widely quoted. It is difficult to find out the magnitude of the effect and whether it is of importance or not in other than pathological cases. Personally, I have never noticed it. Further information on this subject will be welcomed by everyone.

THE WRITER OF THE NOTE.

Perspiration and Erythema

PRELIMINARY spectroscopic experiments have been made to determine the absorption of ultra-violet light by human perspiration. The results, so far only qualitative, indicate that a film of sweat one millimetre thick absorbs light slightly in the region of 3300 A., very appreciably at 2900 A., and is practically opaque at 2700 A. Since sunburn is induced principally by light of wave-lengths lying between 2900 A. and 3100 A., these results indicate that human sweat acts as a partial protection against sunburn to a degree which depends upon the thickness of the layer.

Personal experience rather supports the point of view that sunlight effective in producing erythema is absorbed by perspiration; for, other things being approximately equal, one is usually sunburned more readily on a windy day than on a quiet one. Here the presumption is that the wind keeps the body cool and dry and thus nearly free of perspiration. Better evidence is that of a friend, H. C., who, while canoeing on the Mississippi River with G. P. on a very hot day, frequently dipped his arms into the river, and at the end of the day experienced a severe case of erythema on the arms. On the other hand, G. P., whose arms were likewise exposed to the sun, did not immerse them in the water and suffered merely a modest burn. Both canoeists had commenced the day with a normal summer tan. Assuming the two to have been comparable subjects, one is tempted to the opinion that the frequent immersion of the arms of H. C. kept them free of perspiration, while G. P. enjoyed the protection which the sweat afforded against the actinic rays of the sun.

The constituents of perspiration most likely to be effective in absorbing light in the neighbourhood of 2950 A. are urea, uric acid and certain amino acids. Urea absorbs light in this spectral region slightly, but is nevertheless present in relatively large amount in human sweat. Uric acid has an absorption band with a maximum at about 2900 A., but appears only in small amount in normal sweat. The amino acids, tryptophane and tyrosine, if they appear in sweat, may be effective in producing absorption since they each have an absorption band at about 2900 A.

The fact that normal urine, which contains relatively much more uric acid than does sweat, cuts off rather sharply all light below about 3100 A., suggests that perhaps uric acid may be the primary absorbing agent in human perspiration.

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Aug. 12.

The Profession of Management

IN view of the forthcoming meeting of the British Association and the dominant place accorded to management in Section F* (Department of Industrial Co-operation), a brief explanatory statement of the position of management, as I see it, from a vocational and scientific point of view, may be of interest.

Management, which at the higher levels is the same thing as administration, is tending to become, or made, a 'recognised' profession, comprising (1) practitioners (that is, actual managers); (2) management consultants (corresponding to 'counsel' and 'specialist' in law and medicine); (3) management research workers (corresponding to those in science); (4) educators for (*a*) imparting instruction *about* management (and its associated subjects and sciences), (*b*) training (fitted) people *for* management, or, if already managers, for promotion or advancement.

It will be apparent from (1) that management is in reality not a subject but a functional activity, the activity of directing, organising, controlling and developing in an almost infinite variety of circumstances. Under (2) two functions are distinguishable: (i) management 'auditing' to improve or strengthen the management of an individual concern (in the case of a 'business' increased profits expected as a result), (ii) management 'auditing' to determine, in the case of a 'business', safety as regards financial investment, or suitability of any concern for investment of individual effort. Under (3) the work is largely method- and technique-invention, statistical inquiry and objective psychological investigation (managerial thinking, attitudes, training and vocational selection and guidance). The distinction under (4) is highly important. Its neglect is responsible for much of the ineffectiveness of some university courses. Education may be regarded as the 'mother' function of the new profession as a whole, but as in other fields, only supplementary or preparatory to learning by practical experience.

Since managerial action (or inaction) is based on human decisions and judgments, 'good' management should always be used in preference to the Continental 'scientific' management. 'Good' implies the maximum application of scientific method without eliminating the all-important factors of wisdom and morality.

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Aug. 16.

Experimental Phonetics and Ancient Greek Verse

ANALYSIS of a macrophonic registration[1] of "Devon to Me!" spoken by John Galsworthy[2] showed that 15 of the 40 lines of the poem had a rhythmic form indicated by ⏑́ ⏑ ⏑́ ⏑ ⏑́; an example is the line "Where my fathers stood". This is the form known in ancient Greek metrics as the hypodochmius (for example, "Oed. rex", 1208). Twenty lines had the form ⏑́ ⏑ ⏑ ⏑́; an example is "Watching the sea". This is the choriambus, a very common ancient form. Five lines had the form ⏑́ ⏑ ⏑ –́– as in "Taste of the cream pan!" This is the form termed adoneus. Every line of the poem was spoken with some form of ancient Greek rhythm. The registration of the first stanza of "Drake's Spirit" by Galsworthy himself showed that the line "I, Francis Drake" had the rhythm of the third epitrite ⏑́ ⏑́ ⏑ ⏑́ as in "Medea", 628, and that the line "When the land needs"

had the rhythm of the rising ionic ⏑ ⏑ ⏒ ⏒ as in "Phoen.", 1539.

A registration of "Hickory, dickory, dock" showed a rhythm of ⏒ ⏑ ⏑ ⏒ ⏑ ⏑ ⏒; this is a hemiepes as in "Medea", 412. The line "Gems of a master's art" (Bridges, "Buch der Lieder") was spoken with the rhythm ⏒ ⏑ ⏑ ⏒ ⏑ ⏒; this is one form of the dochmius as in "Agamem.", 1166. "Here a little child I stand" (Herrick, "Grace for a Child") registered with the rhythm ⏒ ⏑ ⏒ ⏑ ⏒ ⏑ ⏒; this is a lekytheion as in "Phœn.", 642. "Tell me thou star whose wings of night" (Shelley, "The World's Wanderers") was spoken with the rhythm ⏒ ⏑ ⏑ ⏒ ⏑ ⏒ ⏑ ⏒; this is the choriambic dimeter as in "Antig.", 332. "Fear no more the heat of the sun" (Shakespeare, "Cymbeline", 2, 4, 249) had the rhythm ⏒ ⏑ ⏒ ⏑ ⏒ ⏑ ⏑ ⏒; this is the choriambic dimeter as in "Antig.", 107. "A wet sheet and a flowing sea" (Cunningham, "A Wet Sheet . . ."), yielded the rhythm ⏑ ⏒ ⏒ ⏑ ⏑ ⏒ ⏑ ⏒; this is a form of the glykoneus as in "Iphig. Taur.", 1097. The line "Ein schönes, wohlgewachsnes Buch" (Ginzkey, "Das Buch"), spoken by the poet himself[3], showed the rhythm ⏑ ⏒ ⏑ ⏒ ⏑ ⏑ ⏒; this is the iambic dimeter, a common ancient form. "Die Damen im schonen Kranz" (Schiller, "Der Handschuh"), spoken by a German, registered with the form ⏑ ⏒ ⏑ ⏑ ⏒ ⏑ ⏒; this is the ancient telesillion.

The lengths of the vowels in ancient Greek verse are known. The examples given here seem to justify the conclusion that, wherever the lengths of the vowels in ancient Greek verse correspond with the lengths in English and German verse as determined by registration and measurement, the rhythmic scheme is the same. Many—perhaps all—the ancient forms may be established on this principle. Greek metrics thus becomes an exact science consisting of numbers obtained by measurements.

E. W. SCRIPTURE.

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62 Leytonstone Road,
London, E.15.
June 28.

[1] See NATURE, 132, 138; 1933.
[2] Janvrin, "Analyse von zwei von John Galsworthy gesprochenen Gedichten", *Z. Exper.-Phon.*, 32, I, 147; 1930.
[3] Scripture, "Anwendung d. graphischen Methode auf Sprache u. Gesang", 73, Leipzig, 1927.

Points from Foregoing Letters

PROFS. F. A. PANETH and G. P. Thomson state that during the bombardment of heavy hydrogen with positive rays (positively charged hydrogen atoms) they had obtained, like Harnwell, Smyth and Urry, measurable amounts of helium; they consider, however, that this is not helium of mass 3 resulting from atomic transmutation, but helium gas adsorbed on the walls of the glass discharge vessel, and afterwards released by the hydrogen.

The only way to explain satisfactorily the long life period of the radioactivity of potassium, according to Dr. K. Sitte, is to assume the existence of a rare isotope of mass 43, which loses an electron and becomes the calcium isotope of the same atomic mass.

From the transitory changes in the absorption spectrum of the liver enzyme catalase, when monoethyl-hydrogen peroxide is added to it, Dr. K. G. Stern deduces the formation of an intermediate compound. This compound breaks down less rapidly than the intermediate compound presumably formed between catalase and hydrogen peroxide, since in the latter case there is no apparent change in the enzyme spectrum.

Dr. E. E. Jelley has studied the dichroism of some rare-earth salts and has found that bands are missing from the absorption spectrum for certain ray directions and planes of vibration. These ray directions for zero absorption differ from band to band, and are not always coincident with the axes of the Fresnel wave surface. He considers that this is strong evidence that at least some of the electronic orbits of the incomplete N shell are fixed with regard to the crystal structure, and that the rare-earth ions as a whole are incapable of free rotation.

The magnetic susceptibilities of single crystals of thallium metal parallel and perpendicular to the hexagonal axis, and their variation with temperature as the crystal changes to cubic symmetry, have been investigated by Prof. S. R. Rao and K. C. Subramaniam. The authors consider that the hexagonal structure is due to the three valency electrons of thallium, while in the cubic structure only the single valency electron is active.

The elastic constants of glass have been calculated by Dr. E. Hiedemann from measurements of the velocity of short (ultra-sonic) compression waves. Observations were made with crossed nicols upon the nodal lines produced in a cube of glass by the transverse waves which bring about double refraction at the position of maximal elastic strain.

An additional wave produced by earthquakes, due to reflection first at the earth's surface and then at the boundary of the earth's core, has been identified at the Dominion Observatory, Wellington. This provides, as R. C. Hayes points out, a method of locating abnormally deep earthquakes from a single record near the epicentre.

Dr. V. B. Wigglesworth has shown that in the blood-sucking bug, *Rhodnius prolixus*, the corpus allatum secretes the active substance which prevents the appearance of adult characters ('metamorphosis') until this insect is full-grown; and also, in the mature female, a substance which causes development of the eggs.

The amount of nitrates and phosphates in the surface waters of the Pacific Ocean off the coast of New South Wales is reduced to a mere trace after the attainment of a maximum in diatom production (for example, in spring), according to Prof. W. J. Dakin and A. N. Colefax; this phenomenon is similar to that observed by Harvey and Atkins in the English Channel.

Experience suggests that one is not so likely to receive severe sunburn when the skin is covered with a thick layer of perspiration. Prof. W. H. Crew has made qualitative spectroscopic observations which show that perspiration absorbs, to a considerable extent, the erythema-producing rays of sunlight. The small amount of uric acid in human sweat may be the principal agent in causing this absorption.

Research Items

Early Bronze

PROF. CECIL DESCH points out the difficulties in determining the sources of ancient tin and copper in a discussion of the origin of bronze (*Trans. Newcomen Soc.*, 14, 1933–34). The term 'bronze' was applied loosely by archæologists to objects which on examination have proved to be copper. Many have supposed that the bronze age was preceded by a copper age, sometimes regarded as of a considerable duration; that the introduction of bronze was accidental; and that a composition of 90 to 10 was arrived at experimentally. This was probable only if native copper was first used and hardened by hammering, casting being discovered later. It is now known that true bronzes are found at a very early date together with copper. The presence of certain 'key' elements, such as nickel and arsenic, affords a clue to the origin of the copper ores. Of two specimens of native copper from Angora and Arghana, the latter was only 97·08 pure, the remainder being tin, iron, nickel and sulphur. On the other hand, the purity of certain ancient objects does not prove the use of native copper. Probably they were obtained by smelting a pure malachite ore. Early Mesopotamian objects are usually free from sulphur, which points to the use of oxidised copper ores. Nickel in early Mesopotamian objects has led to a search for ores containing nickel, and the tentative identification of the Magan of Sargon of Agade as a possible source in Oman. Recently, the presence of arsenic in certain objects has turned attention to Anatolia, Armenia and Caucasia generally. Zanghezour in Azerbaijan is mentioned as the source of Persian and Median copper, and the copper obtained here at the present day shows small quantities of nickel and arsenic. No metallic tin has been found before the eighteenth dynasty. There are few records of its occurrence in those areas of Asia with which the ancient Sumerians were concerned. Importation from Britain or Spain cannot be assumed. Bronze must have originated in the East, but the problem of its origin is unsolved.

Mud-Castle of the Han Dynasty, Chôsen

FOR some twenty years, Japanese archæologists have been engaged in exploring tombs of the Han Dynasty in Chôsen, one of the four provinces instituted by the Emperor Wu-ti in 108 B.C.; but in April 1935 investigation was extended to the 'dojô' (mud-castle), of which indications had been found. According to a report of the excavator, Yoshito Harada (*Proc. Imp. Acad.*, Tokyo, 11, 6), "discoveries of supreme value and importance" have already been made. The ruins of the dojô lie some 6 km. from Heijô in the midst of a tract studded with tombs of the Lo-lang period. The remains of mud walls, tiles and other objects in an area 0·8 km. square, now devoted to farms, pointed to the former existence there of buildings. Excavation brought to light a foot-way, 38 m. long by 8 m. broad. It was paved with tiles, but with marble at the margins. Remains of buildings, 10 m. by 8 m. in area, were excavated. On one wall was found a Korean heater of brick, with a chimney of stone and brick still standing. Among the objects found were a bronze tripod vessel, iron arrowheads, coins, crystal and glass beads, pottery, tiles, etc. The most valuable find, however, consisted of two clay sealings bearing impressions of the seals of Government officials of the districts of T'i-hsi and Pu-êrh respectively. Chinese historical records mention the former in both the earlier and later Han periods, but the latter was in existence only in the earlier. This sealing, therefore, serves to fix the date of the building as certainly not later than A.D. 25. This is the first example of Han architecture to be discovered. The purpose of the building is at present uncertain; but the great number of tiles bearing the inscription "Lo-lang-li-kuan" which have been found suggest that it was the Government office in charge of ceremony. Excavation is to be resumed in the autumn.

Researches on *Calanus finmarchicus*

A CONTINUATION of the important team work on plankton at the Millport Marine Laboratory by Drs. S. M. Marshall, A. G. Nicholls and A. P. Orr which has now been going on for some years has recently been published (*J. Mar. Biol. Lab.*, May 1934, Feb. 1935. "On the Biology of *Calanus finmarchicus*. Part 4. Seasonal Changes in the Weight and Chemical Composition in Loch Fyne. By A. P. Orr. Part 5. Seasonal Distribution and Size, Weight and Chemical Composition in Loch Striven in 1933, and their Relation to the Phytoplankton. Part 6. Oxygen Consumption in Relation to Environmental Conditions. By S. M. Marshall, A. G. Nicholls and A. P. Orr). Following the previous work on size and distribution (Pts. 1 and 2), an attempt was made to ascertain what changes of weight and chemical composition took place throughout the year. It was found that Stage V accounted for much the most important part of the total weight of the catch, and it is usually largest and heaviest when most abundant. Although smaller than the female *Calanus*, Stage V was from the beginning of June to the end of August considerably heavier; its weight fell during the spring and did not increase again until after the end of the first breeding period. In Loch Striven there were three main breeding periods, in February and March, May to June, and in July, with subsidiary broods in August and September. The first brood, which developed when the sea was at its coldest, consisted of *Calanus* of the largest size found during the year; after this there was a gradual fall, corresponding with the warming of the sea. Diatom increases corresponded with the three main spawning periods giving plenty of food for the nauplii. Experiments were made in order to determine the oxygen utilisation by male, female and Stage V. From the amount of oxygen used in respiration, calculations of the food required are made and these are compared with the results given by Pütter for *Calanus* and other copepods. The figures indicate that for Stage V (the most abundant form) and for the adults which require more, the amount of food required daily is very much lower than that calculated by Pütter for *Calanus*.

Crustacea from Polynesia

MR. CHARLES HOWARD EDMONDSON records some very interesting new species in his paper "New and Rare Polynesian Crustacea" (Bernice P. Bishop Museum Occasional Papers, 10, No. 24, 1935). *Mesocaris lauensis* is a new species for which a new genus is created in the Atyidæ. This was taken in a cave containing brackish water on the Island of Namaka and from a salty lake on the Island of Wangana in the southern Lau Islands, Fiji. It represents a very primitive type of Atyd with well-developed exopodites on all the legs and presenting other characters warranting a new genus, but is fairly closely related to *Xiphicaris Paratya* and *Palæmonias*, all of which have exopodites on all the legs, *Paratya* being the only one of these which has penetrated in any degree into the south-west Pacific area. The number of gills is identical in this genus and *Mesocaris*, epipodites being present on the third maxillipedes and all the legs but the last, and in the present species these are peculiarly shaped with a strong terminal hook and a constriction near the free end. Besides these there are seven pairs of gills. The eye pigment is considerably reduced both in the cave specimens and in those of the same species from the brackish-water lake, which is quite exposed. The lake is, however, connected with the sea by subterranean channels, and it is probable that underground caverns and passages connected with the lake have for a long period of time offered habitats encouraging adaptation to a cavernicolous existence. Among the many new finds, a Xanthid crab belonging to a new genus *Nullicrinus*, having atrophied antennæ, is described from Christmas Island.

Insects of Samoa

PART 9, Fasc. 2, pp. 33–104 of "Insects of Samoa", in course of publication by the British Museum (Natural History), consists of a summary by Prof. P. A. Buxton, dealing with the evidence that may be derived from a study of the insect fauna of these islands. While the collection of Samoan insects is far from complete, it forms a basis from which general conclusions may be drawn. Out of the 1,603 species of insects known to occur in Samoa, 49 per cent appear to be endemic. This percentage of endemism is notably lower than that which obtains, for example, in the Hawaian Islands and the Seychelles. The study of the insects, both of those which are absent and those which are present, leads to the same conclusion, namely, that the Samoan fauna is oceanic. There are, however, certain species of insects of specialised habits the occurrence of which is difficult to reconcile with this conclusion. It is clear, and generally admitted, that the fauna of Samoa is essentially Indo-Malayan, but one or two characteristic Australian groups have reached the islands, apparently by natural means. The problem as to how the existing forms of life, or their ancestors, crossed the ocean from Indo-Malaya is a difficult subject. Such questions have long puzzled zoo-geographers and, although we are not yet in a position to answer them, knowledge is advancing in certain particulars. The great stream of anti-trade wind, at no great altitude, may well carry insects and other forms of life eastwards. Recent work on insects found in the upper air suggests that air currents are a much more important factor in distributing small insects than has been realised. Also, the wanderings of oceanic peoples before the advent of the European may have had a considerable influence on the distribution of both plants and insects. In connexion with the transport of insects by means of the traditional floating logs, Prof. Buxton suggests that a study is needed of the effects of sea-water on all stages of insects which have a wide distribution among tropical islands.

The Rhododendron White Fly

THE common white fly of greenhouses is now a well-known plant parasite, but it has other near relations which appear to be equally destructive. Mr. G. Fox Wilson has described one of these (*J. Roy. Hort. Soc.*, 60, Part 6, pp. 264–271, June, 1935). The rhododendron white fly, *Dialeurodes chittendeni*, first appeared in 1926 and is now reported from numerous stations in the south of England. The account under review describes the various stages of the insect, and outlines its life-history. Damage to the host is illustrated by means of very clear photographs. Control may be effected by spraying the lower surfaces of infected rhododendron leaves with a white oil and nicotine emulsion. The Chalcid wasp, *Encarsia formosa*, which parasitises the greenhouse white fly, also attacks its relative on the rhododendron, but low night temperatures and the rather long life-cycle of the parasite militate against its successful use as a control measure.

Experiments on Plant Virus Diseases

THREE papers on various aspects of plant virus diseases by Dr. J. Caldwell, Rothamsted Experimental Station, have recently appeared. "The Control of Virus Diseases of the Tomato" (*J. Minis. Agric.*, 41, 743–749, Nov. 1934) recommends the removal of weeds, avoidance of smoking tobacco (which transmits tobacco mosaic), the early removal of infected plants, and routine fumigation to keep down insect vectors. "Experiments on the Purification of the Virus of Yellow Mosaic of Tomato" (*Ann. App. Biol.*, 22, 68–85, Feb. 1935) discusses various methods of purification, and shows that there is no evidence that virus can be recovered in a crystalline form; infectious material always contained organic nitrogen. The virus was found to be active between *p*H 2·0 and 10·5. A paper "On the Interactions of two Strains of a Plant Virus; Experiments on Induced Immunity in Plants" (*Proc. Roy. Soc.*, B, **117**, 120–139, March 1935) shows that two strains of yellow mosaic virus can be isolated. These are apparently quite distinct as regards characters *in vitro*, and it is suggested that many anomalies in symptom expression of this and other virus diseases can be explained by assuming the presence of strains in the causal agent. A virus strain may inhibit the development of another strain in the same host; the two strains may multiply separately and independently; the second virus may multiply without causing symptoms, or it may add to the severity of the disease produced by the first strain.

Cowpea Rust

A RATHER serious fungus disease of the cowpea (*Vigna sinensis*) reduces the yield of this crop in Egypt. It has been known since 1919, but a full study of its life-history has recently appeared by Dr. Tewfik Fahmy (*Min. Agric. Egypt, Bull.* No. 144, Publications Office, Govt. Press, Bulâq, Cairo, 1935. P.T. 5). The cause of the disease is a rust fungus, *Uromyces vignae*, and produces uredospores,

teleutospores, spermatia and æcidia upon the cowpea. The ten pages of the bulletin are devoted to descriptions of the fungus and its symptoms, with proof of its pathogenicity. Spermatia and æcidia appear during July and August, being quickly followed by uredo and teleuto stages, as the temperature gets cooler and the humidity increases. Twelve half-tone illustrations portray the symptoms and the causal fungus, and a further bulletin, on the selection of varieties of cowpea immune to the disease, is promised.

Kinetics of Photosynthesis

In a recent theoretical paper, Prof. E. C. C. Baly (*Proc. Roy. Soc.*, B, **117**; 1935) has derived equations to express the known variations in the rate of photosynthesis in varying conditions. The treatment is based on the supposition that the photosynthetic process consists of three distinct stages: (*a*) the union of chlorophyll *a* with hydrated carbon dioxide; (*b*) an oxidation-reduction reaction in which the chlorophyll *a* – carbonic acid complex is converted photochemically to chlorophyll *b* and activated formaldehyde; (*c*) the Blackman reaction in which, it is suggested, chlorophyll *b* is reduced by carotin to chlorophyll *a*, and xanthophyll is produced. The condition in which the velocity of oxidation of chlorophyll *a* to chlorophyll *b* in the light reaction is equal to the velocity of its regeneration by the Blackman reaction is described as a "photostationary state". It is this condition which is defined by the equations, which are shown to express with noteworthy accuracy the variation in rate of photosynthesis with temperature, the theoretical curves agreeing well with Emerson's data on *Chlorella*. These equations are extended to express the influence of varying total light intensity, carbon dioxide concentration, intermittent illumination and the effect of poisons. Prof. Baly's view that the primary photosynthetic reaction consists of two consecutive light reactions, stimulated by blue and red light, is expressed by equations modified in this respect, and data calculated from these equations agree well with the observations of Briggs and Warburg on the effects of varying the relative intensities of red and blue light. Baly's formulation of the Blackman and light reactions will not be received without criticism, but if it is admissible as a basis for hypothesis, the subsequent mathematical treatment will form an interesting addition to the theory of photosynthesis.

Eocene Foraminifera

In a memoir on the Upper Eocene Foraminifera of the south-eastern United States (U.S. Geol. Surv., Prof. Paper 181; 1935), J. A. Cushman describes 203 species or varieties from the Jackson formation. The sediments are variable in character, some being of very shallow water nature, others much deeper. The foraminiferal faunas show differences corresponding with differences in the depth of the deposits. The shallow water type resembles the fauna of the shallow water in the Indo-Pacific region rather than the living fauna of the West Indies. On the other hand, the deeper water fauna is much more closely allied to the fauna still living in the Gulf of Mexico and the West Indian region. T. W. Vaughan and others have already pointed out the resemblances of the early Tertiary corals, etc., of the West Indies to genera now living in the Indo-Pacific region.

Sound Insulation

The issue of the *Journal of Research of the Bureau of Standards* of June contains Research Paper 800 on "Recent Sound Transmission Measurements at the Bureau of Standards" by Messrs. V. L. Chrisler and W. F. Snyder. The source of sound is a loudspeaker mounted on a rotating arm so that it describes a circle 5 feet in diameter. It can emit nine frequency bands between 128 and 4096 cycles per second, each band of width 20 per cent of its middle frequency. The chamber in which the sound is produced has walls 6 inches thick of reinforced concrete and is about 10 ft. × 12 ft. × 12 ft. It is insulated by 3 inches of air from a chamber by its side and another above it, and the panels to be tested can be inserted in the wall or ceiling. Measurements of sound pressure are made by means of a microphone placed in turn on each side of the panel under test and at different distances from its centre along its normal. Detailed results are given for 28 panels tested, and confirm the laws that a solid homogeneous wall must be very heavy to be a sound insulator, and that dividing it into layers as loosely connected as possible increases greatly its sound insulating properties.

Transport Numbers of Salts

The older measurements of transport numbers by the so-called moving boundary method were subject to considerable doubt, and the utility of the method had been questioned. A series of careful measurements with the use of improved apparatus made by MacInnes and others showed that the method is capable of giving very satisfactory results, and it has been used to determine the transport numbers of several salts. On the simple ionic theory, the transport number is regarded as constant; but it is now known to depend on concentration, so that a comparison of conductivities at different concentrations does not give the degree of ionisation without further correction. The mobilities of individual ions as functions of concentration may be obtained by combining transport numbers with conductivities, and accurate values of activity coefficients may be obtained from transport data and electromotive force measurements with certain cells with liquid junctions. Some further measurements of transport numbers by the moving boundary method, and a useful summary of previous results, are given by L. G. Longsworth (*J. Amer. Chem. Soc.*, **57**, 1185; 1935). The paper contains tables for the transport numbers of several salts in aqueous solutions at 25° at various concentrations. Two types of boundaries are distinguished, namely, autogenic boundaries, formed automatically by the electrochemical solution of an appropriate metal anode, and sheared boundaries, made by the superposition of leading and indicator solutions. The latter involves a special mechanism, first described by MacInnes and Brighton, by means of which one solution is superposed on another with a minimum of disturbance to either solution. Although the moving boundary method may be used over a wide range of concentration if the proper indicators are available, it is most useful in the interval 0·01–0·2 *N*. Outside this range, sources of error become important. Solvent and volume corrections must be applied, the first for the conductance of the solvent and the second for the changes in volume of solution by transfer of electrolyte. Recent measurements by the Hittorf and moving boundary methods are in agreement.

An Apparatus for Rearing Marine Organisms in the Laboratory

By Dr. F. G. Walton Smith (Commonwealth Research Fellow)

ALTHOUGH the life-histories of the most important marine organisms have been worked out in the past, there is very little known in many cases regarding the detailed changes that take place during the critical stages separating larval life from that of the adult, while the study of the physiology of invertebrate larvæ has been almost entirely neglected.

These gaps in our knowledge are partly due to the minute size of many of the larvæ, but also in large measure to the difficulty experienced in rearing them in the laboratory. Even though the most scrupulous care be taken in sterilising instruments and vessels, and in keeping physical and chemical conditions of the environment 'normal', this difficulty remains; and it is a common experience to find that larvæ will live in plunger jars for days and weeks longer than the natural period of their free-swimming existence without increasing in size or developing organs characteristic of the metamorphosing stages. On the other hand, attempts to provide food in the form of organisms isolated from the microplankton, though occasionally successful, are usually doomed to failure, owing to the ease with which the physical, chemical and biological factors of the environment in a restricted volume of water pass beyond our control, and to our ignorance of the actual food requirements.

If, however, a continuous flow of fresh sea-water can be supplied to the organisms in sufficient quantity, not only will physical and chemical conditions remain stable, but also food organisms of the kind available under natural conditions will be provided, and in sufficient concentration to permit of normal growth and development. It was found necessary recently, in order to study the metamorphosis and biology of the larval oyster, to construct an apparatus that would satisfy this requirement, and make it possible to undertake the rearing of all stages in development with a high degree of certainty. The apparatus (Fig. 1) and procedure described below have given consistently satisfactory results, not only with the larvæ of the common American oyster, but also with later stages of *Ostrea equestris*, and species of *Chiton*, *Crepidula* and *Fissurella*.

The type of vessel employed is the cylindrical jar used in some fish hatcheries, and is about 18 in. high and 6 in. in diameter, with a conical base (B). This shape has the advantage that on stopping the flow of water the larvæ quickly settle to the bottom and are readily collected. In order that the flow of water may not carry away the small larvæ (early stages of *Ostrea virginica* are less than 0·06 mm. in smallest dimension), the outflowing water is removed from the rearing jar by means of a siphon (S_3), the wide mouth of which (F_2) is covered by a fine net of bolting silk. Rapid clogging of the pores of this material is prevented by dipping the mouth of the siphon under the surface of molten paraffin wax melting at a temperature of 48° C. and then blowing air through the other end as it is removed. The resulting smooth coating of wax on the fibres of the net seems to prevent the entanglement of the larvæ, and allows the filter to work efficiently for a much longer period than otherwise would be the case. The net is fitted to the siphon by means of a rubber band.

The sea-water supply is taken from the reservoir feeding the main laboratory circulation, replenished by pumping from the sea once or twice a week. Where there is no such source of supply, it is necessary to use a supply tank which is replenished when needful with sea-water taken at high tide.

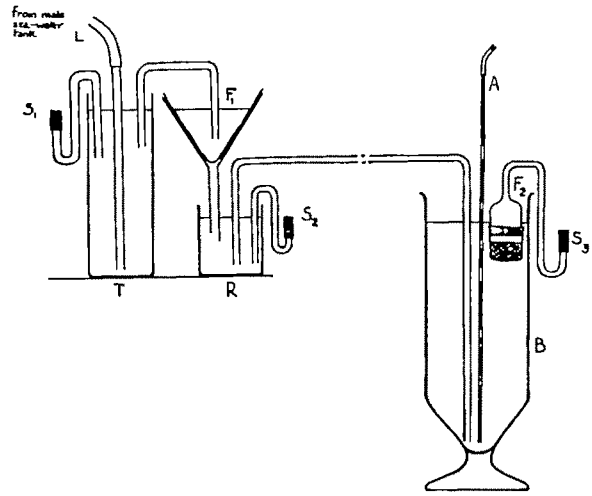

FIG. 1.

Whereas the exit siphon is placed at the top of the jar, the sea-water enters the vessel through a glass tube extending to the bottom of it, thus making a good circulation of water possible. It is important that the sea-water supply should also be filtered, and to the same extent as the outflow, in order to guard against the accumulation of detritus and the admission of predatory organisms. This is conveniently carried out, by means of a square piece of bolting silk supported in a filter funnel (F_1). Aeration and circulation of the sea-water in the jar are accomplished by means of a glass tube (A) connected with a compressed air supply and extending to the base of the jar.

In order to prevent the sea-water from entering the jar faster than it is removed, with subsequent loss of the larvæ, and in order to prevent an overflow from the filter funnel, a constant level siphon (S_2) is attached to the reservoir (R) supplying the rearing jar, and a similar arrangement is fitted to a vessel (T) feeding the filter. The constant-level siphons may be adjusted by means of small pieces of rubber tubing on the outer arms. The rate of flow of the sea-water through the rearing jar is regulated in this way, and is dependent upon the vertical distance between the outflow of siphons S_2 and S_3.

The use of this apparatus is not confined to the rearing of organisms alone. A series of rearing jars may be connected to the same supply reservoir, and if eggs from a single artificial fertilisation are distributed among them in equal numbers, they will

be able to develop under exactly similar conditions, providing a basis from which biological and physico-chemical conditions may be varied for experimental purposes. In order to analyse food requirements, for example, jars to which food organisms and solutions of different kinds are added, and which are supplied with sea-water filtered through a porcelain candle filter, may be set up for comparison with the arrangement previously described.

This apparatus has been found to give a sufficient approximation to 'normal' conditions to enable larvæ to be reared through the most critical stages of development, while in use at the Beaufort, N.C., station of the U.S. Bureau of Fisheries, this summer. My acknowledgments are due to the Bureau and to Dr. Herbert F. Prytherch, director of the Station, for hospitality and advice accorded to me during the time when I was making use of it there.

Archæological Research in Western China

ALTHOUGH archæological research in China has not yet afforded confirmation of the annals of the third millennium B.C., with which its recorded traditions open, excavation in the north and centre has brought to light not only cultures of the neolithic and bronze ages, but also inscriptions in a primitive script, which in a measure corroborate tradition and justify the attribution of authenticity to the dynasty of a period of some centuries before that of Cheo (1122 B.C.), hitherto regarded as the earliest dynastic record worthy of any degree of credence. The west must now be added to the regions of China in which archæological research has produced not only evidence of early civilisation, but also corroboration of a record which stands in a different category.

Recent excavations at Hanchow (*J. West China Border Research Society*, 6, 1933–34) point to an early cultural connexion of the west of China with the north and centre, which may even go back to a much earlier date, if, as is suggested by an eminent Chinese scholar, Dr. Ko Mo Jo, an inscription on bone tablets from Anyang, which records the appearance of men of Shuh in the fighting ranks, and belongs to the Yin dynasty (1400–1122 B.C.), may be taken to refer to Szechwan, of which the ancient name is Shuh. For the fortunate result by which this important addition has been made to knowledge of the prehistoric cultures of China, archæology is indebted to members of the West China Border Research Society, and more especially to Dr. David Graham, curator of the West China Union University Museums, who intervened at a crucial moment to guide the zeal of the Chinese authorities for excavation into channels which would ensure the scientific value of the investigation.

The excavation at Hanchow is one only of a number of activities in which the West China Border Research Society, which was founded in 1922, acting in close co-operation with the Union University, is promoting the advancement of scientific research in the extremely interesting and important border area of western China and eastern Tibet. Its headquarters at Chengtu serve as a focusing point for activities in geographical exploration and studies in anthropology, botany, zoology and medical science, which carry on the scientific work of members of the missionary bodies, who promoted the West China Union University. By their own researches and by their co-operation with members of other scientific expeditions, they did much to promote scientific knowledge of this region long before the University came into being in 1910. The University Museums, which now have 53,334 specimens, distributed among the three Museums of Archæology, Art and Ethnology, the Natural History Museum and the Museum of Medical and Dental Sciences, owe much to their efforts, especially in the ethnographical section, which contains material such as cannot be found in any other museum. The Society's journal, now in its sixth volume, contains much valuable matter, especially worthy of regard in the anthropological world, as the Society, both in its publications and in the organisation of research among its members, is bound in the terms of its constitution to concentrate on regional and other investigations which bear on problems relating to the little-known non-Chinese peoples of the area.

As regards the excavations at Hanchow referred to above, the accidental discovery in 1931 of stone and jade rings, knives, discs and other objects in a pit at T'ai-p'ing-ch'ang, eighteen *li* from Hanchow, when an irrigation ditch was being deepened, pointed to the possibility of a prehistoric burial, which was confirmed by systematic excavation in 1934. In addition to the original pit, the ground immediately surrounding was carefully explored and several points in the area were also tested. No further grave pits were found, but everywhere there was abundant material which appeared to be mainly the refuse from a group of ancient pottery kilns.

The preliminary account of the excavation includes also an analysis of the physical characters of the jade and stone objects by Prof. D. S. Pye and of the pottery by Prof. H. B. Collier. A comparison of the culture with that found at Yang Shao and Anyang in Honan and that from Sha Kuo T'un in Fengtien points to interesting resemblances as well as differences. Thus there is no painted pottery at Hanchow or Sha Kuo T'un such as was found by Dr. J. G. Andersson at Yang Shao. Both the Hanchow and the Yang Shao cultures have large and small stone axes, chisels, knives, pestles or hammers, and flat discs, and both incised and cord-marked pottery. In both the potter's wheel is known. At neither, nor at Sha Kuo T'un, is there metal; whereas at Anyang there is abundant bronze, associated with a primitive writing on bone, bone implements and painted pottery.

Though Yang Shao and Sha Kuo T'un are classed as neolithic, the use of the wire saw at Hanchow and resemblances to Cheo objects suggest that the Hanchow site is later than æneolithic. In all probability it cannot be later than the beginning of the Cheo dynasty (1122 B.C.); but it is almost certainly later than the bronze culture of Anyang, which belongs to the Yin dynasty (1400–1122 B.C.). Thus it must represent a retarded development of the west.

Veneer and Plywood

FOR veneers and plywood, some of the hard tropical timbers, often showing beautiful colouring and figuring, are becoming better known. Research on wood for veneer and plywood has been carried out for some time at the Research Institute at Dehra Dun. In *Indian Forest Records* (Economy Series, **20**, 14. Delhi: Manager of Publications, Dec. 1934), Mr. W. Nagle, who is in charge of the Woodworking Section, discusses the "Testing of Indian Timbers for Veneer and Plywood". The purpose of the monograph is "to assist, as far as possible, the advancement of the plywood industry in India, and to further the use of indigenous timbers for veneer and plywood work".

Only those who have followed the development in the use of plywood during the last two decades will have a conception of the variety of purposes to which it is put at the present day. The author reminds the reader that the art of veneering was practised by, and certain forms of laminated construction were used by, the ancient Egyptians. But in Great Britain and for many centuries in Europe, solid wood was used both in house construction and for furniture. Modern demands for luxury articles at a cheap price have assisted and encouraged the use of plywood; but it would be misleading to think that the great demand for this material has been the result of any consideration for the conservation of valuable timbers. The truth is that at the present day every country which possesses areas of forest containing valuable, that is, luxury timbers is, by means of research work and otherwise, endeavouring to place them on the world markets.

It is well known that plywood has come into use in the manufacture of furniture and panelling. But it is worthy of placing on record the following list of other articles which are nowadays formed or built out of this fabricated material: cabin trunks, suit cases, perambulators, and even musical instruments such as violins and mandolins are made of either veneer or plywood. The modern motor-car has considerable amounts of plywood in its make-up, for example, floor boards, hood-stays, body-work, roofing and panelling. Other plywood or veneered articles in common use are chairs, theatre seats, wall panelling and ceilings, screen scenery and stage buildings for the cinema industry and theatres, railway carriages, dining saloons and 'sleepers'. The modern ship is fitted with plywood tables, bulkheads and general appointments. Parts of motor-boats, canoes and life-boats are often constructed of the same material; also aeroplanes and airships. Finally, chests are now made for tea, opium, cement, rubber, etc.; as also fruit and cigarette boxes.

It will be obvious that the above list is capable of indefinite extension. That it has reached its present dimensions gives evidence of the considerable amount of research and experimental work which has been carried out during the past few decades.

Mr. Nagle's monograph is based on research carried out during the past ten years with Indian timbers, upon which little was known as to their suitability or otherwise for veneers and plywood. It is technical in character, with a number of interesting photographs, and deals with some forty-two Indian timber trees.

Genetics of Size and Form Factors

THE problems of size and form inheritance are more difficult than many other problems in genetics, partly because the character units cannot usually be directly observed; they are often represented by multiple factors in the germ plasm, and they are also obscured by fluctuations.

Messrs. Sinnott and Dunn (*Biol. Reviews*, **10**, No. 2) have summarised our knowledge of the effects of genes on the development of size and form in plants and animals. Their summary is particularly useful because they emphasise the developmental and physiological aspects of size inheritance, although making it clear that fixed genic differences are involved. They point out that some dwarf types both in plants and animals are due to single factors, while many other size differences are due to several multiple factors. The differences may be in cell size, as in some of the polyploid and trisomic forms, or in cell number, or to both acting together. Size genes may depend upon general developmental differences controlled by particular metabolic rates.

In races of large rabbits the rate of cell division very early shows itself to be more rapid, and there is evidence that such races have a higher concentration of sulphydryl. Differences in fruit size in tomato varieties are due to differences both in cell number and cell size. Up till the time the flower opens, all the tissues of the ovary are meristematic. Subsequent growth is due to increase in size of the cells. In large-fruited varieties the ovary is larger, but cell enlargement is also carried much further. There appears to be a particular schedule or pattern of growth, involving both cell size and cell number, in each variety. The study of the inheritance of size of parts or organs involves heterogonic growth and Goldschmidt's physiological theory of heredity.

The conception of genic balance is involved, as in the trisomic Daturas, where the genes in one chromosome increase and those in another decrease the size of the pith, while other chromosomes affect the relative amounts of xylem and phloem. Thus while size genes may be general in their action, they may also have a special influence on certain parts. As shown by studies of inheritance of fruit shape in *Cucurbita* and the combs of fowls, as well as the proportions between various bones, it is evident that shape factors usually affect not single dimensions but two or three dimensions, through differences in growth rate.

Science News a Century Ago

Submarine Navigation Experiments

The Times on September 1, 1835, said: "According to the Paris papers, some curious experiments have lately been made at St. Ouen near Paris, with a submarine vessel, the invention of M. Villeroi, the engineer. The vessel is of iron, and of the same shape as a fish of the cretaceous tribe. Its movements and evolutions are performed by three or four men, who are inside, and who have no communication with the surface of the water, or the external air. With this machine navigation can be effected in spite of currents; any operations may be carried on under water, and it may be brought to the surface at will, like an ordinary vessel. It was with a machine similar to this that the project was formed in 1821 for getting away Napoleon from St. Helena. The Société Générale des Naufrages (protector, the King) has appointed Admiral Sir Sidney Smith, Count Godde de Liancourt, the Baron de St. Denis and Dr. Daniel St. Antoine to report on the experiments to be made at St. Ouen."

Ireland and the British Association

THOUGH the British Association meeting in Dublin in August 1835 was generally regarded as a success, some adverse comments on it were made in the *Dublin University Magazine*, extracts from which were published in *The Times* on September 4. "We cannot conceal our conviction," the *Magazine* said, "that for the purposes of the advancement of science the association is little better than useless. . . . The association, we prophesy, will soon see its end. . . . We rejoice, however, that it has lived long enough to visit Ireland; we rejoice that its visit to this island has been marked by so many traits that confer honour upon our country and our countrymen. We rejoice in anything that can confer honour upon 'ould Ireland', and so having said enough, perhaps some will think too much, upon a subject which we could not pass over in silence, we will leave the 'savans' and the association to go their ways in peace, and we will return with a good heart and an honest purpose to our own labours—labours that, though we may say it 'that should not say it' will do more than 50,000 British Associations to make that same 'ould Ireland'

'What she ought to be—great, glorious and free,
First flower of the earth, and first gem of the sea'."

Lyell in Switzerland

ON September 6, 1835, Lyell wrote to Viscount Cole (afterwards Earl of Enniskillen) from Meiringen, giving an account of the work he had done in Switzerland just before he left to attend the meeting of the German naturalists at Bonn. He had visited Berne, made excursions to Neuchâtel and the Jura and had taken soundings in the Lake of Thun. "But I found," he wrote, "when I attempted to understand the geology of the neighbourhood of the lake of Thun, even with Studer's newly published book and map and sections as he calls them in my hand, that I could not at all comprehend it, nor make out what he meant by his numerous formations. I therefore determined to make myself master if possible of the geology of this part of Switzerland, on which much more has now been written than on any other part of the Alps, before I make an attack on less known districts. This I have in some measure accomplished; but in doing it and climbing the Jungfrau and the Urbach Sattel, I have spent the time which was to have been given to Glaris which I hope, however, is postponed. I must now proceed at once on my way to the Bonn meeting. . . ."

One of Faraday's Mistakes

FARADAY'S entry in his "Diary", on September 6, 1835, opens with the paragraph: "Rose tells me that Berzelius in his annual account objects to my antimony proto sulphuret, and I am therefore hastened to its examination the first thing this autumn, having meant to defer it awhile before Rose told me this."

The supposed new compound had been referred to by Faraday in his "Seventh Series of Experimental Researches in Electricity", published in 1834, and described as having been prepared by fusing together the "ordinary sulphuret of antimony" with metallic antimony. He now, in September 1835, repeated the fusion more carefully, and analysed the product. The result differed from that previously obtained, for on September 12 the entry appears: "My former conclusions appear to be wrong, whatever the cause of this difference may be". He thereupon wrote off to the *Philosophical Magazine* withdrawing the new compound, saying that Prof. Rose on a visit to London had told him of Berzelius's objections, and that he had been "induced to make more accurate experiments on that point, which showed me my error". The letter, with a translation of Berzelius's paper, was duly published in June 1836.

Societies and Academies

PARIS

Academy of Sciences, July 8 (*C.R.*, 201, 105–180). RICHARD FOSSE, PAUL EMILE THOMAS and PAUL DE GRAEVE: The estimation by weight and the identification by elementary analysis of small quantities of formol in very dilute solutions. The method is based on the reaction of formol with β-naphthol, and determines formol at concentrations between 30 and 200 parts per million, with an accuracy of one per cent or less. HENRI DEVAUX: The insolubility of thin plates of albumen. H. GRUYELLE and CHARLES POISSON: The magnetic anomaly of Tsiafajavona. MARC KRASNER: The theory of the ramification of ideals. H. AUERBACH and S. ULAM: The number of generators of a semi-simple group. PAUL MONTEL: Positive harmonic functions. OCTAVE ONICESCU: Holotope functions. ANDRÉ AURIC: An empirical formula giving the distances at which the successive rings of the nebular hypothesis are formed. MLLE. MARGUERITE ROUMENS: The systematic inclination to the west of the equatorial solar prominences of mean latitudes. DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The continuous spectrum of Nova Herculis. DIKRAN G. DERVICHIAN: The interpretation of the Eotvos constant and of its different values. NICOLAS STOYKO and RAYMOND JOUAUST: The propagation of short radio-electric waves in the region of the polar aurora. LOUIS NÉEL: The number electrons which contribute to the paramagnetism of nickel. The study of nickel alloys shows that an electron of the alloy metal annuls the magnetic contribution of a nickel electron. There is complete continuity between ferro- and para-magnetism, and

the same electrons intervene in both cases. LÉON and EUGÈNE BLOCH: The spectra of zinc, cadmium and mercury in the extreme ultra-violet. GEORGES DÉCHÊNE: The influence of the passage of an electric current on the phosphorescence of zinc sulphide. MAURICE CURIE: The hyperbolic law of the decline of phosphorescence. MAURICE PROST: The radiation accompanying the dehydration of quinine sulphate. The ease with which the radiation can be deflected shows that it is not due to large ions, thus differentiating this emission from that arising from the oxidation of phosphorus. HENRI MOUREU and PAUL ROCQUET. The structure of phosphorus pentachloride and of phosphorus pentamide $P(NH_2)_5$. PIERRE CARRÉ and DAVID LIBERMANN: The reaction of thionyl chloride with *m*- and *p*-aminobenzoic acids. ROBERT LANTZ: Study of the mechanism of the monosulphonation of naphthalene. GEORGES DARZENS and ANDRÉ LÉVY: The action of organomagnesium compounds on methylnaphthalenic and phenanthrenic esters. JACQUES DE LAPPARENT: The stages of the metamorphism of the Samos emeries. PIERRE DRACH: The modifications undergone by the skeleton in the decapod Crustacea before casting the shell. GEORGES A. NADSON and MME. CATHERINE STERN: The action of metals at a distance on germinating seeds. The inhibiting effect on growth produced by plates of various metals is shown to depend on the radioactivity of the surrounding air. MME. VÉRA DANTCHAKOFF: The differences of sensibility of tissue receivers towards folliculin at various embryonic stages. MME. MARIE PHISALIX and FÉLIX PASTEUR: The action of short waves on antivenom snake sera as well as on their neutral mixtures with the corresponding poisons. THÉOPHILE CAHN and JACQUES HOUGET: The transport of lipids in the animal organism. ANDRÉ BOIVIN and MME. LYDIA MESROBEANU: The presence of a 'complete' antigen and of a 'residual' antigen in various bacteria. A. BESREDKA, I. MAGAT and P. BESNARD: The importance of the mode of entrance in the evolution of the Pearce-Brown epithelioma. Testicular epithelioma of the rabbit, resulting in fatal generalised cancer, changes its character when it is inoculated under the skin. The tumour on the skin, although epitheliomatous in structure, is benign and is resorbed. PIERRE LÉPINE: The comparative action of immersion in glycerol and of freezing on the preservation of the virulence of rabic marrows. The usual method of preservation in glycerol at about 0° C. leads to a gradual loss in activity, due to the action of the glycerol. Freezing at − 10° C. leads to no loss of activity for at least 70 days. CONSTANTIN LEVADITI, RENÉ MARTIN, ANTOINE BONNEFOI and MLLE. RACHEL SCHEN: The etiology of mumps. RAYMOND-HAMET: Some pharmacological effects of ergometrine, a new alkaloid from ergot of rye. JEAN CUILLÉ, CHELLE and BERLUREAU: The identity of French and Algerian ovine anaplasmosis.

LENINGRAD

Academy of Sciences (*C.R.*, 2, Nos. 3–4, 1935). A. GELFOND: Approximations of transcendent numbers by algebraic numbers. J. PRIVALOV: Some questions of the theory of subharmonic functions (2). E. KUZNECOV: The law of probability of an accidental vector. A. POPOV: Some results obtained by V. Brun. I. S. ASTAPOVICH and V. K. FEDYNSKIJ: Heights of meteors. G. KRUTKOV: A note on the 'great complexes' of Gibbs and the method of Darwin and Fowler. W. ARKADJEV: Magnetic and electric spectra in high frequency. V. FREDERICKS, G. MICHAJLOV and D. BENESZEWICZ: Electroconductivity of an anisotropic fluid. V. FESENKOV: Luminosity of the night sky at Kitab, Tashkent and Kuchino. N. N. KALITIN: Intensity of the radiation from the sky at wave-lengths 3292 A., 3595 A. and 3944 A. E. A. SHILOV and G. V. KUPINSKAJÁ: Rate of hydrolysis of chlorine. N. D. ZELINSKIJ: Catalytic aromatisation of benzines. A. L. KLEBANSKIJ, U. A. DRANICINA and I. M. DOBROMILSKAJA: A new trimeric combination of acetylene, acetylenyldivinyl. N. I. KOBOZEV, S. S. VASILJEV and E. E. HALBRAICH: Catalytic influence of mercury vapour on the cracking of methane in a glow discharge. V. V. TCHELINZEV: Oxonic compounds. Acid compounds of chinones and their chlorination and bromination. G. V. TCHELINZEV and E. D. OSETROVA: The α-benzoylbutyrolactone, γ-benzoyl-propyl-alcohol and γ-benzoyl-propyl-bromide. M. K. DJAKOVA and A. V. LOZOVOJ: Hydrogenation of Cheliabinsk brown coal. V. TETERIN and A. IVANOV: Investigations on the synthesis of vitamin A. (1) Action of magnium on a mixture of 1,4-dibrombutene-2 and ionon. A. E. FERSMANN: Energy indices in geochemistry. S. D. CHETVERIKOV and A. F. FIOLETOVA: Celadonite from Koktebel, Crimea. V. I. DANILOVICH: Scheme of stratigraphy of the Khingan complex. O. S. VIALOV: A classification scheme of tertiary strata in Ferghana. O. S. VIALOV, S. F. MASHKOVCEV and G. I. SHATOV: Cretaceous basalt in Ferghana. O. L. EINOR: A detailed stratigraphical section of the super-carboniferous of the Kizel district, Urals. P. P. LAZAREV: The action of a condenser discharge from the point of view of the ionic theory of excitation. D. KOSTOFF and I. A. AXAMITNAJA: Studies on polyploid plants (9). Chemical analysis of diploid and their autotetraploid plants. L. P. BRESLAVEZ: Differential fertilisation of the hemp plant. B. M. GOLUSH: Changes of the plasma permeability induced by temperature effects. R. M. BARCINSKIJ: The agent stimulating sprouting of *Orobanche cumana* seeds. S. V. SOLDATENKOV: Data on the chemistry of the artificial ripening of the Japanese persimmon (*Diospyros kaki*, L.). I. KOZHANCHIKOV: Role of anoxybiotic processes in the larval diapause of some *Pyralidæ*. L. K. LOZINA-LOZINSKIJ: The anabiosis of larvæ of *Pyrausta nubilalis*, Hübn., after freezing. J. D. KIRSCHENBLATT: The problem of the origin of some nidicoles (nest dwellers). B. A. ZENKOVICH: Whale fœtuses.

MELBOURNE

Royal Society of Victoria, July 12. F. CHAPMAN and IRENE CRESPIN: Foraminiferal limestone of Eocene age from North-West Division, Western Australia. Eocene sedimentary rocks have been discovered for the first time in Australia, during the survey by Messrs. E. A. Rudd and D. Dale Condit, of the Bullara Area. Two samples of limestones from slightly different localities contain a foraminiferal fauna of a Lower to Middle Eocene age. R. A. KEBLE: Victorian Tertiary flora and its influence on sedimentation. The plant beds at Narracan, Dargo, Darlimurla, Bogong, Berwick and probably Moonee Ponds are regarded as of Eocene age, those at Bacchus Marsh, Mornington, Haddon and the lignites at Yallourn (Morwell), Altona and other places as Oligocene, the Pitfield plant bed as Lower Miocene, and the Sentinel Rock plant bed as late Miocene. The flora indicates

that a subtropical climate persisted to the middle of the Miocene and the vegetation was similar to that in the region of the Tropic of Capricorn. The Sentinel Rock flora suggests a temperate climate and vegetation similar to that in Victoria and Tasmania.

VIENNA

Academy of Sciences, June 13. ERNST ROUSCHAL: The dependence of the intake of water by entire plants on the temperature. The lowered absorption of water brought about by cooling the roots of plants to 0° C. does not resume its normal value when the temperature is afterwards made normal, and the course of the recovery varies with different plants. GERHARD KIRSCH and FRITZ RIEDER: Disintegration of nitrogen by neutrons. In this disintegration, two processes, both connected with capture of the neutron, take place. In one, an α-particle and B^{11} are formed by emission, and in the other, which is much rarer and is effected mainly by the more rapid neutrons, C^{14} arises, presumably by proton emission. HERBERT SCHOBER: Measurement of the daily and monthly variation in the length of the ultra-violet for the solar and zenith spectra at Watten (Tyrol). OTTO DISCHENDORFER: Condensation of benzoin and hydroquinone.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, September 1

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Birds" *

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (NORWICH MEETING)

Wednesday, September 4

At 8.30 p.m.—Prof. W. W. Watts: "Form, Drift and Rhythm of the Continents" (Presidential Address in the Agricultural Hall).

Thursday, September 5

At 10 a.m.—Prof. W. N. Haworth: "The Molecular Structure of Carbohydrates" (Presidential Address to Section B).

Prof. F. Balfour-Browne: "The Species Problem" (Presidential Address to Section D).

Prof. F. Debenham: "Some Aspects of the Polar Regions" (Presidential Address to Section E).

Mr. J. S. Wilson: "Stability of Structures" (Presidential Address to Section G).

Friday, September 6

At 10 a.m.—Dr. F. W. Aston: "The Story of Isotopes" (Presidential Address to Section A).

Prof. G. Hickling: "Some Geological Aspects of Recent Research on Coal" (Presidential Address to Section C).

Prof. J. G. Smith: "Economic Nationalism and Foreign Trade" (Presidential Address to Section F).

Dr. Ll. Wynn Jones: "Personality and Age" (Presidential Address to Section J).

Dr. A. W. Pickard-Cambridge: "Education and Freedom" (Presidential Address to Section L).

At 2 p.m.—Conference of Delegates of Corresponding Societies. Prof. P. G. H. Boswell: "Preservation of Sites of Scientific Interest in Town and Country Planning" (Presidential Address).

At 8.15 p.m. Dr. S. J. Davies: "Diesel Engines and Coastal Shipping" (Agricultural Hall Assembly Room).

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1639 (T. 3527 revd.): Wind Tunnel Wall Interference on Pitching Moments of Large Models in Duplex Tunnel. By W. L. Cowley and G. A. McMillan. Pp. 13+4 plates. 9d. net. No. 1648 (T. 3628): Reaction on a Wing whose Angle of Incidence is changing Rapidly; Wind Tunnel Experiments with a Short Period Recording Balance. By W. S. Farren. Pp. 24+30 plates. (London: H.M. Stationery Office.) 2s. 3d. net.

The Harper Adams Adviser. Advisory Report No. 10: A Review of Advisory Work in the West Midland Province, 1934-1935. Pp. 24. (Newport, Shropshire: Harper Adams Agricultural College.)

Mines Department. Thirteenth Annual Report of the Safety in Mines Research Board including a Report of Matters dealt with by the Health Advisory Committee, 1934. Pp. 134. (London: H.M. Stationery Office.) 2s. net.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1934. Pp. x+261. (London: H.M. Stationery Office.) 4s. net.

The North of Scotland College of Agriculture. Calendar, Session 1935–1936. Pp. viii+128. (Aberdeen: North of Scotland College of Agriculture.)

Technical Publications of the International Tin Research and Development Council. Series A, No. 19: The Use of Sodium Sulphite as an addition to Alkaline Detergents for Tinned Ware. By Dr. R. Kerr. Pp. 12. Series A, No. 20: The Twinning of Single Crystals of Tin. By Dr. Bruce Chalmers. Pp. 16. Series B, No. 2: Equilibrium Diagrams of Binary Alloys of Tin. By Dr. E. S. Hedges and Dr. C. E. Homer. Pp. 90. Series D, No. 2: Black Spots on Tin and Tinned Ware. By Sven Brennert. Pp. 27. (London: International Tin Research and Development Council.)

Other Countries

Regenwaarnemingen in Nederlandsch-Indië. Vier und vijftigste Jaargang, 1932. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.)

Colony of Mauritius: Department of Agriculture. Fifth Annual Report of the Sugarcane Research Station for the Year 1934. Pp. 49. (Port Louis: Government Printer.)

Publications of the Observatory of the University of Michigan. Vol. 6, No. 9: An Ephemeris of 467 A.D. By Heber D. Curtis and Frank E. Robbins. Pp. 77–100+2 plates. (Ann Arbor, Mich.: University of Michigan.)

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 16: Formaciones sedimentarias de Patagonia. Edición Oficial ordenada por El Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 747+193 plates. (La Plata: El Gobierno de la Provincia de Buenos Aires.)

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 27, 1934. Prepared by E. T. McPhee. Pp. xxxii+942. (Canberra: Government Printer.) 5s.

U.S. Department of Agriculture. Technical Bulletin No. 477: *Apanteles solitarius* (Ratzeburg), an introduced Braconid Parasite of the Satin Moth. By D. L. Parker. Pp. 18. (Washington, D.C.: Government Printing Office.) 5 cents.

Publications of the Astronomical Observatory of the Warsaw University. Vol. 9. Pp. iii+76. (Warsaw: Astronomical Observatory.)

Tanganyika Territory: Department of Agriculture. Annual Report, 1934. Pp. 141. (Dar es Salaam: Government Printer.) 4s.

The Imperial College of Tropical Agriculture. The Principal's Report for the Year 1933–34 and the Accounts for the Year ended August 31, 1934. Pp. 34. (Trinidad and London: Imperial College of Tropical Agriculture.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 14, 1932. iv. Meteorologiska iakttagelser i Sverige, Band 74. Pp. x+107. (Stockholm: Statens Meteorologiska-Hydrografiska Anstalt.) 7.00 kr.

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 5, Part 1: The Intensity of Fraunhofer Lines in the Region 4036–6600 A. By C. W. Allen. Pp. 57. Memoir No. 5, Part 2: Fraunhofer Intensity Tables: (a) General Intensity Table, 4277–6600 A.; (b) Multiplet Intensity Table, 4036–6600 A. By C. W. Allen. Pp. 96. (Canberra: Government Printer.)

Institut de France: Académie des Sciences. Annuaire pour 1935. Pp. 407. (Paris: Gauthier-Villars.)

Transactions of the Academy of Science of Saint Louis. Vol. 29, No. 1: Natural History of the Alligator Lizards. By Henry S. Fitch. Pp. 38+4 plates. (St. Louis, Mo.: Washington University.)

Smithsonian Miscellaneous Collections. Vol. 91, No. 21: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Fourteen New Species of Foraminifera. By John A. Cushman. (Publication 3327.) Pp. ii+9+3 plates. Vol. 91, No. 22: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Two New Foraminifera of the Genus Textularia. By Cecil G. Lalicker. (Publication 3328.) Pp. ii+2+1 plate. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Agriculture. Circular No. 349: The Disposal by Burial of Fruit infested with Larvæ of the Mexican Fruit Fly. By C. C. Plummer and W. E. Stone. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents.

Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Directorate. Notes and Memoirs, No. 6: The Pharynx and Intestinal Tract of the Egyptian Mullets—Mugil Cephalus and Mugil Capito. Part 2: On the Morphology and Histology of the Alimentary Canal in Mugil Capito (Tobar). By Dr. F. M. Ghazzawi. Pp. ii+31. Notes and Memoirs, No. 7: Repeuplement Poissonnier des sources à l'Oasis de Siwa. Par Dr H. Faouzi. Pp. ii+12+5 plates. Rapport sur les Pêcheries d'Egypte en 1932. Par Ibrahim Abd-el-Gahi Abou-Samra. Pp. xx+117. (Cairo: Government Press.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3436 SATURDAY, SEPTEMBER 7, 1935 Vol. 136

The Changeful Earth

THE address of Prof. W. W. Watts, F.R.S., this year's president of the British Association, appears in the supplement to the present number of NATURE. In the "Form, Drift, and Rhythm of the Continents", he has a very big subject, covering many topics that are debatable, for geology is a highly controversial subject when we get down to principles, and is likely to remain so for a long time to come.

Uniformitarianism is referred to briefly, and the help that Darwin admits he obtained from a consideration of this and kindred topics as set forth by Lyell is mentioned; but is it not going too far to say that Lyell only just missed the discovery of organic evolution? If he only just missed it, why was his recognition of its truth so tardy? Is it permissible to attribute heroism to Lyell because in the long run, and very reluctantly, he admitted its truth? In any event, the principle of uniformitarianism, while no doubt essentially sound, should be applied with some caution; for it is not difficult to believe that dynamic agencies acted much more impetuously on the earth's crust during the early stages of its history than they did during later times, and even during later times there are some results the explanation of which seem to call for an occasional display of impetuous dynamic agencies. Later on in his address, in the portion dealing with the nature of the interior of the earth, Prof. Watts acknowledges this, and arrives at a view which "is neither strictly uniformitarian nor strictly catastrophic, but takes the best from each hypothesis". The important fact to note is, however, as he points out, that taking the earth as a whole "the chain of life has never snapped", and organic evolution has proceeded continuously throughout the traceable history of the earth's crust.

In a brief outline of the geological story of the earth, the idea of rhythm is developed, involving the alternation of periods of land growth with periods of marine transgression, as advocated by Suess. To account for this rhythm, Prof. Watts refers to the theory of the earth's contraction by loss of heat, and he seems to regard this as the factor of prime importance in the explanation of mountain growth and rock folding. He points out, however, that some geologists have found this theory inadequate, because in their opinion it is unable to account for the large amount of compression involved in mountain building.

A consideration of the age of the earth gives Prof. Watts an opportunity of emphasising the importance of radioactivity in the earth's crust as a hidden reserve from which it replenishes the supply of heat it requires to make good the losses sustained by radiation, and of remarking on the ample sufficiency of this reserve to explain the great age of the earth. Here he states Joly's view that, as a result of radioactivity, dissipation of the earth's energy, although continuous, proceeds by a process of pulsation, and that this furnishes the explanation required to account for the rhythmic alternation of land growth and marine transgression already referred to. Prof. Watts is apparently a strong supporter of this view, for he assures us that, "As Darwin found the missing word for Lyell, so Joly in his theory of thermal cycles has indicated the direction of search for a mechanism to actuate the rhythm of Suess". Here we are in some difficulty, for in connexion with

this view it is suggested that continental masses are embedded in a substratum of denser rock matter, in which they float as do icebergs on water; and whether we believe this or not, we may reasonably doubt if it can be harmonised with the theory that rock folding and mountain building are the outcome of tangential compression due to loss of heat and consequent contraction of the earth's mass.

The portions of Prof. Watts's address dealing with the Atlantic and Pacific Oceans, and with continental drift, will be read with much interest by geologists, as this subject has been widely discussed in recent years. In dealing with it, Prof. Watts contents himself with a recital of published pros and cons, showing on the whole an affectionate regard for the pros, while leaving us with the impression that he has not quite made up his mind. He points out the structural contrasts between the shore lands of the Atlantic and those of the Pacific. He further mentions the rough parallelism between the two coast lines of the Atlantic, the close resemblances between the structure, rocks and fossils in the land areas bordering the two coasts, and various other features that have been brought into the account to support the hypothesis of continental drift, which Wegener did so much to popularise some years ago, and which on that account usually carries his name. According to this hypothesis, the above-mentioned Atlantic features are to be explained partly by the view already mentioned as supported by Joly, that continental masses float in a denser substratum like icebergs on water; and partly by the view that the Atlantic margins represent one of many fractures which dissected what was formerly one vast continental mass, and that the separate masses thus defined by fractures have since drifted apart as a result of differential rotation or some other cause. To satisfy those who have difficulty in accounting for the Western Cordilleras of the Americas, the advocates of continental drift explain that these are due to the piling up of rock masses against obstacles which have arrested the drifting movement, and the same rather shabby explanation is applied to the origin of the Himalaya and some other mountain masses.

Prof. Watts no doubt sees many difficulties in the way of accepting this hypothesis, although, from the support he gives to Joly's views, one would expect him to be an out-and-out supporter of it. He realises, however, that its basis is purely speculative, for he tells us that the only way to settle it is by making more exact and longer-period measurements of longitude and latitude than have hitherto been possible. Unfortunately, however, such variations as have been recorded are, we are told, well within the limits of error involved in the observations. Indeed, pending the establishment of a stronger groundwork of fact for this hypothesis, the older theory of foundering subsidence for the origin of the Atlantic, and ordinary tangential compression for the origin of mountains, seems decidedly preferable.

In a concluding section on the evolution of life on the earth, reference is made to changing physical and biological influences as quickening or checking competition, and thus affecting the rate of evolution. The case of the grasses receives special mention. The geological date for the appearance of this important group of plants is given as early Tertiary (probably late Eocene) times. Not only is this group of plants important as a source of wheat and many other foodstuffs on which mankind depends directly; they are also of importance indirectly as nourishers of numerous kinds of animals that serve as human food. The appearance of these grasses was a factor of immense importance during Tertiary and later times in stimulating the evolution of the vertebrates, including man, whose brain, Prof. Watts tells us, is of all the wonders of the known universe the most wonderful, "the most intricate and efficient mechanism ever devised, . . . capable of inspiring and ruling great masses of mankind".

A lofty note is struck in the last paragraph of this interesting address, which spreads before us such a varied feast of scientific thought concerning the earth on which we live. In the concluding six words of this last paragraph, Prof. Watts speaks of "the golden ages that have gone". He almost persuades us to think, however, that "the best is yet to be, the last of things for which the first was made"; for he assures us that we are still far from the end of the mighty purpose that shows itself in the evolution of life on the earth, and that we can look forward with confidence to a further advance. Fortified by this assurance, we may reasonably hope that *Homo sapiens*, the wonder-brained creature that proudly labels itself "heir of all the ages, in the foremost files of time", will, in the coming years if not in the immediate future, show by wise governance in world affairs that it is worthy of the great earthly heritage into which it has entered.

T. C.

Man Conquers the Desert

The Desert Fayum
By G. Caton-Thompson and E. W. Gardner. Vol. 1. Pp. xiv + 167. Vol. 2. Pp. vii + 114 plates. (London: Royal Anthropological Institute of Great Britain and Ireland, 1934.) 30*s*. net.

THESE two handsome volumes present with a wealth of detailed evidence the results of three seasons' pioneer work in the arid desert of the Fayum depression. Regions, previously traversed only by camels or donkeys, had to be opened up to motor-cars; water had to be supplied to gangs of native excavators encamped twenty-five or more miles from the nearest spring; the intrigues of other expeditions had to be circumvented. In the face of these obstacles the authors completed a contoured map of 100 square miles within the depression, and an archæological and geological survey of a much wider area.

The geological conclusions of the expedition have been published already in specialist journals. The present book merely notes the subsequent confirmation by the Geological Survey of Egypt of Miss Gardner's figure for the maximum level of the Pleistocene lake and of the existence of a rock sill across the Hawara channel that finally disposes of a rival theory of the origin of the lake: otherwise, ignoring controversy, the conclusions are just restated here. In Pleistocene times a great lake filled the depression to 115 ft. above sea-level; it then dried up almost completely, to be succeeded after an indefinite interval by a Neolithic lake with its highest beach at 59 ft.; the second lake contracted by stages until its strand lay 7 ft. below sea-level in Old Kingdom times and afterwards shrank even faster towards the present Birket Qarun. The pauses in the contraction of the lake must be due to increased rainfall, but nothing like a 'pluvial period' is admitted in holocene times. Maps and tables show how the archæological remains must be correlated with the several stages in the contraction of the Neolithic lake. Thus the laborious levelling and plotting, epitomised in these charts, serve to establish the relative ages of the human cultures to the description of which the bulk of the text is devoted.

The co-operation of several sciences secured to the expedition three outstanding triumphs. First, it provided the solution to the problem which first attracted Miss Caton-Thompson to the Fayum—the classification of the remarkable flint tools collected there and the determination of their relative age and cultural status. The makers of the oldest—Neolithic *A*—flints lived along the shores of a lake, 180 ft. above the modern lake-shore, and were allied to, and probably contemporary with, the oldest neolithic peoples discovered (after the first seasons' work in the Fayum) in the Nile Valley at Tasa and on the edge of the Delta at Merimde. With the discovery of their makers' actual settlements, silos, grains and household equipment, the long-familiar flints can be seen as marks of what is perhaps the oldest food-producing community yet known to archæology. Meticulous excavation, followed here by exhaustive publication, has yielded a vivid picture of this early phase of civilised life, while its scientific value is enhanced by expert reports on grains, animal bones and other materials.

To British prehistorians, the Fayum culture should appeal particularly, since Menghin has shown that our oldest neolithic culture is ultimately sprung from the same stock. On its origins the authors are wisely non-committal. (One reason for their reluctance to admit an eastern origin will have been removed by Mallowan's discovery of emmer nearly as early in Assyria.) In any event, though the Fayum *A* culture is the best illustration of a critical stage in man's progress, it is not the starting point of the new economy; the barley from the neolithic granaries, for example, is almost as far removed from its wild ancestor as is that grown in Egypt to-day. The primary stages in the plant's domestication must therefore be sought in a still remoter past.

Nor does the Fayum reveal any development of its oldest culture. The next phase, when the lake had sunk 20 ft., witnesses rather a degeneration. To it belong microlithic tools which on old typologies would have been classed as 'pre-neolithic'. The first advance comes with the Egyptians of the Old Kingdom. The expedition discovered gypsum and dolerite quarries of that age and forgotten roads leading across the desert to the Pyramids—a triumph nearly as dramatic as the recognition of the older neolithic culture. It adds materially to our appreciation of the industrial organisation of the Old Kingdom. The authors found a village of more than two hundred hut-circles (quite like those so familiar in Britain) in which the gypsum workers were housed, no less than 3,233 unfinished vases and piles of flint-nodules—the raw material for quarryman's picks. The collection and transportation of these heavy flints from a considerable distance must itself have employed a multitude of labourers. The discovery in the village of a rope

of undoubted camel hair and of horn-cores belonging probably to *Bos brachyceros* should be noted by zoologists, since both animals are reputedly foreign to the early holocene of Africa.

The expedition's third triumph was the identification of a Ptolemaic irrigation system. The canals had been completely masked by sand, but were revealed to Miss Caton-Thompson's expert vision by seedlings that, after a shower, sprouted most luxuriantly along the line of the old channels. Excavation defined the character of the channels, fixed their date and showed that they had rendered possible the cultivation of vines and date-palms on this now treeless waste. In this instance, archæology may prove to have a positive economic value.

V. GORDON CHILDE.

Philosophy of Modern Physics

(1) Science and the Human Temperament
By Prof. Erwin Schrödinger. Translated, and with a Biographical Introduction, by James Murphy. Pp. 154. (London: George Allen and Unwin, Ltd., 1935.) 7*s*. 6*d*. net.

(2) Science and the Human Temperament
By Prof. Erwin Schrödinger. Translated by Dr. James Murphy and W. H. Johnston. Pp. 192. (New York: W. W. Norton and Co., Inc., 1935.) 2.50 dollars.

THESE two books are identical but that the one published in America has an error on the title page, where the author is wrongly described as "formerly" professor in Berlin.

The essays here published together were produced at various times for various occasions, but they are all philosophical discussions of modern physical theory designed for the general public more than for the professional physicist. The essays are all most readable and written in a lively and even provocative manner. The last of them is Prof. Schrödinger's Nobel Prize lecture and contains a simple account of the ideas underlying his well-known, if little understood, wave theory of matter. The author explains that, just as light for some purposes can be treated as consisting of rays moving in straight lines, for others it can be treated as a system of transverse waves, which can spread round obstacles; so also the electron for some purposes can be treated as a particle, for others as a wave system. The difficulties underlying the theory are essentially those that arise when we try to translate concepts that have been developed to deal with the familiar large-scale operations of Nature into terms which are applicable to operations on the smallest scale of the elementary units. The older physicists assumed that no translating was needed and that their concepts applied through and through, although they were anthropomorphic in the sense of being derived from the ordinary mechanical arts.

The other essays deal in the main with two other difficulties of a similar kind. One of these has now been apparent for a long time, ever since it was realised that the laws which are found by observation to describe the behaviour of gases, the transfer of heat, the progress of chemical reactions, and so on, are based upon complete chaos of the individual particles making up the things that are actually handled experimentally. The regularities appear only because the individual particles are handled in very large numbers, just as insurance companies remain solvent because large numbers of people take out policies. The other is the more novel Uncertainty Principle of Heisenberg: the assertion that there is necessarily a rigid limit to the accuracy of observation, a limit determined by a natural constant. Hitherto it had been assumed that—in principle at any rate—observations could be made with any degree of accuracy; though now, after the event, it is easy to see that the assumption never had a leg to stand on. Prof. Schrödinger points out that even if this principle introduces a new sort of indeterminism, classical theory was not so strictly deterministic as has been popularly supposed. You can never specify more about the motion of an object than that at t_0 it is at p_0, and after a finite interval, at t_1 it is at p_1, and so on. At least two observations are needed, and all observations are limited by the fact that the scales of instruments have a finite number of divisions at finite intervals.

The writings of Eddington and Jeans have popularised the notion that modern physical theory leads inevitably to some kind of 'Idealism' similar to that of Berkeley. Prof. Schrödinger's treatment provides no warrant for this view, and on this point we would emphatically contradict the suggestion Mr. Murphy makes in his introduction. Mr. Murphy and the other translator have, however, done their translating very well; there is none of the awkwardness so often apparent.

A. D. R.

Physiology and Pathology of Internal Secretion

The Diseases of the Endocrine Glands

By Dr. Hermann Zondek. Third edition, revised and enlarged, translated by Dr. Carl Prausnitz. Pp. xi+492. (London: Edward Arnold and Co., 1935.) 40*s*. net.

THE addition of yet another volume to works on diseases of the endocrine glands can only fill the expert reader with dismay, unless such a work has outstanding characters. The work at present under review, from the theoretical point of view, has everything against it; for it deals mainly with the pathology of the endocrine glands, is written by an author well known for very strong personal views, and it is a translation from the German. It may be stated at the outset that despite these difficulties the work forms a most valuable addition to the literature of this subject. Dr. Hermann Zondek is well known as a member of the distinguished scientific family of which his brother, Prof. Bernard Zondek, has contributed perhaps some of the most striking developments of modern endocrinology.

The volume is divided into two parts, part one being concerned with the general physiological and biochemical principles of the glands and internal secretions, and part two solely with the pathological changes. A good historical review is given in part one, the functions of the hormones, their mode of action and the question of specificity are carefully considered and the site of action in the body briefly discussed.

The section dealing with the actual chemistry and physiology of the hormones is rather disappointing. Thus, a more detailed description of the reasons for the adoption of the Harington formula for thyroxine should have been given. The summary of the present position of our knowledge of the hormones of the anterior and posterior lobes of the pituitary gland is very good, but one would have liked more details of the chemical properties of these substances. Again, it is unfortunate that Dr. Zondek has not gone more fully into the question of the chemistry of the male and female sex hormones. For example, the very important recent developments whereby sex hormones may be obtained as degradation products of certain sterols is not made at all clear. It is, of course, difficult for the author of such a volume to know what to include, since the subject is so vast; but for future editions we would suggest that more chemical details are given, since these are the basic facts of our knowledge of the endocrine glands.

In the special part of this work, Chapter xii is concerned with Graves' disease, and is a very good summary of our present position. There can be no doubt that the greater part of this description will be new to chemical and clinical readers. The whole subject of hyper- and hypo-thyroidism is considered from a hormonal aspect. The description of the treatment of hyper-thyroidism is particularly interesting, although all will not agree with some of Dr. Zondek's remarks; for example, on p. 169 he implies that there is no use whatsoever for digitalis in Graves' disease. Other chapters deal adequately with the subjects of myxodæma, cretinism and endemic goitre.

There is an excellent chapter on obesity. Dr. Zondek very wisely points out that the fundamental consideration in the problem of obesity is the excess of intake over output. The endocrine glands can only accentuate or diminish this fundamental consideration. Many writers on endocrinology tend to give the impression that even the first law of thermodynamics can be defied. Various types of obesity are dealt with, such as Frölich's syndrome, Dercums' disease and similar conditions.

The work is undoubtedly one of very great value. One may perhaps be irritated by the writer's emphasis of his opinion, but perhaps it is this factor that gives the book that freshness which is absent from most works of this kind. It is to be hoped that it will be read extensively by physicians and particularly by gynæcologists and obstetricians, who seem to be unmoved by the truly amazing progress made in their subject by endocrinologists. They have been presented with gift after gift, such for example as the Aschheim-Zondek reaction, but they appear to pay little attention to this branch of their work.

The book is well produced, with good and well-selected illustrations. The work differs from most translations in that the casual reader would not realise it is a translation, and this is perhaps the greatest compliment one could pay to Dr. Prausnitz. Some of his translations are extremely apposite; for example, "Mastfettsucht" is translated simply as "overfeeding", whereas "Luxuskonsumption" is "alimentary extravagance". Dr. Zondek is to be congratulated on producing one of the best books on the subject and Dr. Prausnitz on supplying the perfect translation.

Sir Ray Lankester as Archæologist

Prehistoric Archæology and Sir Ray Lankester
By J. Reid Moir. Pp. viii + 160. (Ipswich: Norman Adlard and Co., Ltd., 1935.) 7*s*. 6*d*.

SIR RAY LANKESTER was one of the most versatile and inspiring scientific men of his generation. His own researches in biology and geology were remarkably varied, but his active interest in the work of others was still more comprehensive. He watched each new development and did not hesitate to form his own opinions on the evidence produced. He frequently entered discussions on problems outside his immediate sphere, and helped to illuminate them by his keen appreciation of their nature and possible mode of treatment.

Among other problems which interested Lankester were those of prehistoric archæology. As a young man he visited Abbeville and Boucher de Perthes, who gave him examples of the palæolithic flint implements which were then being discovered in the valley of the Somme. In his later years, from 1910 onwards, he followed with close attention the researches of Mr. J. Reid Moir, who was finding still older and more primitive flint implements in the bone bed at the base of the Pliocene "Red Crag" in Suffolk. In 1911 he described Mr. Reid Moir's new implements in a paper read before the Royal Society, and gave to them the now familiar name of 'rostro-carinates'. In subsequent years he continued to make further contributions to the subject.

From 1910 until his death in 1929, Sir Ray Lankester wrote many letters to Mr. Reid Moir during the progress of his researches and publications. They are full of characteristic comments and helpful suggestions, and the most important parts of them are now printed with a connecting narrative by Mr. Reid Moir in the small volume before us. Some relate to the Red Crag and its basement bed, which Lankester studied and described so long ago as the years 1865–70. Some give hints for the study of the fracture and patination of flints; others offer excellent advice on the writing of scientific papers. Some deal with current researches on fossil man and his handiwork outside East Anglia. They tell a most interesting story, which we commend both to archæologists and to all who wish to see science in the making.

A. S. W.

Tables of the Complete and Incomplete Elliptic Integrals
Reissued from Tome 2 of Legendre's "Traité des Fonctions Elliptiques", Paris 1825. With an Introduction by Karl Pearson. Pp. xliii + 94. (London: *Biometrika* Office, University College, 1934.) 12*s*. 6*d*. net.

COPIES of Legendre's classical work, "Traité des Fonctions Elliptiques", published in Paris in 1825, have now become very scarce, with a consequent rise in price. To the mathematician, this has considerably diminished the accessibility of the fundamental tables of the complete and incomplete elliptic integrals E and F, which were contained in Volume 2 of the treatise. By means of the photographic process, however, it has now been possible to republish the tables, and the present volume is the result. Not the least valuable part of the book is the excellent introduction written by Prof. Karl Pearson. Here we have 39 pages devoted to a lucid explanation of the tables and their use. Several interesting diagrams are shown and a beautiful autographed portrait of Legendre is included. As the tables are a photographic reproduction, the book is larger than usual, but all those whose work necessitates the use of the tables will be grateful to the *Biometrika* Office for issuing such a valuable work of reference at so reasonable a price.

Gasentladungstabellen:
Tabellen, Formeln und Kurven zur Physik und Technik der Elektronen und Ionen. Von M. Knoll, F. Ollendorff und R. Rompe. Unter Mitarbeit von A. Roggendorf. Pp. x + 171. (Berlin: Julius Springer, 1935.) 29 gold marks.

A VERY considerable proportion of modern physics is concerned with electrical phenomena in more or less evacuated vessels. The worker in this general field, whether his special interest be in thermionics, in light-sources for spectroscopy, or in any other of its many branches, needs at one time or another information about the properties of a vast number of things. He may require the ionisation potential of cæsium, the vapour pressure of cadmium at 100° C., the specific resistance of molybdenum at 1,000° C., or the relative rates of sputtering of aluminium and iron cathodes in a hydrogen discharge. All these data, and hundreds more, can be found in this very useful book, which contains in graphical or tabular form an immense amount of quantitative information of value to workers on electrical discharges.

The authors have been commendably careful in making clear the units in which the various quantities are measured, and the sources from which the information has been obtained. The index, which is of the greatest importance in a book of this kind, seems to be quite adequate.

A Bibliography of Sir Oliver Lodge, F.R.S.
Compiled by Theodore Besterman. Pp. xiv+220. (London: Oxford University Press, 1935.) 21*s*. net.

SIR OLIVER LODGE has for many years been a clear and prolific writer on many subjects, and Mr. Besterman has collected a list of 1,156 books, pamphlets, articles, letters, notes, etc., in scientific, technical and other journals and books written by Sir Oliver in the past sixty years. Of these, 247 relate to electricity and wireless communication, 54 to questions concerning the ether, 289 to other scientific subjects, 70 to psychical research in general, 73 to survival after death, 64 to education, 170 to philosophy and religion, 118 are biographical or are reviews of or prefaces to books by other authors and 71 are on miscellaneous subjects. An index of 23 pages, which distinguishes typographically between books and pamphlets on one hand and contributions to periodicals on the other, facilitates reference to the book.

In the preface, Sir Oliver has added some further information as to his early demonstration of wireless signalling at the meeting of the British Association at Oxford in 1894, and the developments which followed. The book is well printed, and the portrait of Sir Oliver which forms the frontispiece is very good and shows him in a characteristic attitude. An absence of cross references throughout the book makes it difficult to follow the course of discussions on psychical or religious subjects between Sir Oliver and his critics. Sometimes a reply is tabulated without the criticism, at others the criticism without a reply, as for example, Sir Herbert Stephen's criticism of "Raymond" on p. 111. No hint is given that Prof. Armstrong's article, xxi p. 191, entitled "Sir Oliver Lodge, Intolerant, Infallible", is the fourth member of a quartette, the others being Sir Oliver dcvi p. 102, Sir Ray Lankester xxix p. 191, Sir Oliver dcxi, p. 103. The roman numerals for articles throughout the book, as for example, "Science and Psychical Research dccccxlviii", instead of 948, p. 215, of the index, detract considerably from the ease of reference to the Bibliography.

The Origins of Religion
By Prof. Rafael Karsten. Pp. viii+328. (London: Kegan Paul and Co., Ltd., 1935.) 12*s*. 6*d*. net.

PROF. KARSTEN, in formulating his theories of the origins of primitive religion, is in a position to draw upon an extensive acquaintance with the beliefs of backward peoples, especially in South America, at first hand. He is thus able to meet the more serious critics of the comparative method in the study of religion on their own ground, when they impute neglect or ignorance of the context as a fatal flaw in the argument. On the other hand, although he himself maintains the predominance of animism and ancestor worship as formative influences in the religious side of man's cultural development, he points out that those who have followed Tylor and Spencer have frequently been entirely uncritical in the use of authorities upon whose evidence they have based the evolutionary view of the growth of religion.

Prof. Karsten is to be regarded as in the main an evolutionist, though he is no upholder of the crude view of a unilateral line of development. On the other hand, he is ready to recognise that diffusion and *kulturkreise* are not to be ruled out, and that they, too, have played their part. Preanimism or animatism, however, finds no favour as a precedent to animism, and is regarded as late and sophisticated.

The book is an excellent and well-balanced review of current theory and reinterpretation of the evidence in the light of personal first-hand knowledge. Its value is enhanced by the use the author has made of evidence afforded by the beliefs of Finno-Ugrian peoples which, owing to difficulties of language, are not generally accessible.

Terrains, roches et fossiles de la Belgique
Par Eug. Maillieux. Deuxième édition, revue et augmentée. Pp. 217. (Bruxelles: Musée royal d'Histoire naturelle de Belgique, 1933.) 6 belgas.

THIS work is an excellent summary of the present state of knowledge of the stratigraphical geology and palæontology of Belgium, and while invaluable to geologists, sufficient explanatory matter is given to make the book of use to readers with only a small knowledge of the subject. With the exception of the Cambrian system, the range of formations is almost as extensive as in the British Isles, and the deposits, in the main, resemble those of these islands. The palæontological record really starts with the Tremadocian, there being no definite evidence to show whether earlier formations are of Cambrian or pre-Cambrian age. Three maps show the outcrops of Palæozoic, Mesozoic and Tertiary formations respectively, from which it is seen that the Mesozoic deposits occupy a relatively small area, the Palæozoic form most of the southern part of the country, and the Tertiary the northern part. Intrusive and extrusive igneous rocks are of little importance.

The palæontology of each system and its divisions are lucidly described and illustrated by numerous figures. Interest is given to the stratigraphical facts by an account of the conditions under which the deposits were formed and of the geographical changes which took place during each period. A new section across the Ardennes by Prof. F. Kaisin is welcome.

Opera hactenus inedita Rogeri Baconi
Fasc. 12: Questiones supra librum de Causis. Nunc primum edidit Robert Steele, collaborante Ferdinand M. Delorme. Accedit Liber de Causis a Roberto Steele. Pp. xxiv+196. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 17*s*. 6*d*. net.

THIS excellent edition of Bacon's commentary on the "Liber de Causis" brings nearer to completion the publication of the works of the erudite Franciscan friar of the Middle Ages. The thesis and the commentary are printed separately, following the method used by medieval writers. The history of the MSS. used for this edition is given by Mr. Steele in a comprehensive introduction. The work deals with some fundamental points of ontology, such as being, substance, cause and the intellect. T. G.

Robert Hooke and his Contemporaries

"DR. ROBERT HOOKE is generally allowed to have been one of the greatest promoters of Experimental Natural Knowledge, as well as Ornaments of the seventeenth century, so fruitful of great genius." With suchlike words Richard Waller begins his introduction to the "Posthumous Works", and the judgment still holds good. Nevertheless, our information as to Hooke's life and character has hitherto been comparatively meagre, for Ward's "Life", and most of what has besides been written of him, derives from Waller's account, and Waller apparently had little personal knowledge of Hooke or his intimates, since he states that his main authorities are Hooke's brief biographical notes and the "Journals" of the Royal Society. It is typical that Hooke is one of the few great men of science of whom no portrait is available—possibly the only one, for even of Cavendish we have the well-known sketch prefixed to George Wilson's "Life" and the "Scientific Papers". Hard judgments have been pronounced on him, without, perhaps, much trouble taken about that understanding which is said to lead to comprehensive pardon. The publication* of Hooke's diary for 1672–80, now in the possession of the Corporation of the City of London, at least affords us some direct evidence as to his character and mode of life.

This Diary covers the period of the "Cutlerian Lectures" and "Philosophical Collections". Hooke was thirty-seven years old when he started it, and had already published the "Micrographia" and made some of his most important improvements in instruments, including the first Gregorian telescope with a pierced objective mirror, but was still in his scientific prime. The diary consists of brief entries in staccato style, as can best be shown by a typical entry.

"Monday June 15th Rose at 4. Mr. Amhurst desired a meeting this day at 3. Tryd helioscope by reflection. Hurt my eye much—prosecuted Hevelius. Was at Lord Mayors and coffee house with Sir Ch. Wren. Lord pleased with accounts. Oliver a Rascall. Dean of Paules angry. At Garaways. Met Mr. Amhurst, 1 Guinny. View in Fleet Street 10sh. At Mr. Tompions".

It might be thought that this kind of thing would soon pall, but one reader at least has found it fascinating. The "Cutlerian Lectures", the "Philosophical Collection", and Birch's "History of the Royal Society" go far to elucidate obscurities and amplify allusions, while the Diary makes the formal records extraordinarily vivid and personal.

For general interest this Diary does not, of course, challenge comparison with Pepys, but we must respectfully dissent from the judgment implied in the charming words of introduction by the honoured president of the Royal Society, Sir Frederick Gowland Hopkins, that the difference in style is partly attributable to the fact that Hooke's diary was meant for himself alone, while Pepys had his eye on eventual readers. Surely the fact that Pepys, who used a special secret shorthand, was essentially a gossip and a man about town, while Hooke was a man whose interests were concentrated on pure and applied science, and who had no interest in public affairs and society, as distinct from The Society, supplies a sufficient reason. It is much to be regretted that the two diaries do not overlap in time, Pepys's concluding three years before Hooke's starts, but it is amusing to note that the two men, of such different temperaments, met and liked one another. There are several references to Hooke in Pepys, the first speaking of "Mr. Hooke, who is the most, and promises the least, of any man in the world that ever I saw". Elsewhere we read:

"Discoursed with Mr. Hooke about the nature of sounds and he did make me understand the nature of musicall sounds made by strings, mighty prettily; and he told me that having come to a certain number of vibrations proper to make any tone, he is able to tell how many strokes a fly makes with her wings (those flies that hum in their flying) by the note that it answers to in musique, during their flying. That, I suppose, is a little too much refined; but his discourse in general of sound was mighty fine".

Thus the president-to-be (1684–86) of the Royal Society. On the other hand Hooke, in his briefer style, writes: "I was twise with Mr. Pepys who was very civil and kind", and even if he says later "Mr. Pepys master of the Trinity House made a long speech to no great purpose", it is only his way of stating that it was a "little too much refined".

What does the Diary tell us? We premise that it is obviously a truthful personal record, written without any thought of possible readers. Hooke sets down with a symbol every passage—and at one time they were frequent—with his mistress Nell Young and with her successors, and a host of pitiful details of his troubled health. Entries like

* The Diary of Robert Hooke, M.A., M.D., F.R.S., 1672–1680. Transcribed from the Original in the possession of the Corporation of the City of London (Guildhall Library). Edited by Henry W. Robinson and Walter Adams. Pp. xxviii+527+8 plates. (London: Taylor and Francis, 1935.) 25s.

"Drunk. Promised to pay whatever I signed to be paid" show that he spared himself no less than others in his directness. The first thing that stands out clearly is that Hooke was a sick man, trying all the time with medicine and diet to win a little ease. He was troubled constantly with what appears to have been a form of catarrh in his nose, with terrible headaches, with vomiting, with giddiness, with sleeplessness, with indigestion in various forms, and with fearful dreams—possibly also with worms, for he frequently took what he calls hagiox, which is probably hagiospermum, that is, santonin, which nowadays, at any rate, is only used for that trouble. Nevertheless, only occasionally was he too ill to work—"Ill all day, miserere mei deus". When anything agreed with him, or he slept, he thought it worth noting. "Eat nuts and brandy. Agreed well, and slept". "Slept well. Deo Gratias". The medicines which he took almost daily make a formidable list.*

There is some excuse, then, for Hooke's reputed ill-temper. Not only, however, was he without ease and sleep; it is clear that he was prodigiously overworked. "The indefatigable Hooke", Weld may well call him. What is sometimes forgotten is that Hooke was a considerable architect, so much so that the College of Physicians in Warwick Lane has been attributed to Wren, although it appears that it was Hooke's. In any event, he was the architect for Bethlehem Hospital, to which very many entries refer, and he appears to have been responsible for the urn on the Monument, which gave some trouble. He designed private houses for many individuals mentioned in the Diary. He had been appointed City Surveyor in 1666, in which capacity he was assisting Sir Christopher Wren all through the period of the Diary, so that there is scarcely a page on which Sir Christopher is not mentioned. There are frequent records of his being with Sir Christopher and, incidentally, with Robert Boyle, Sir J. Hoskins, and other famous men, a circumstance to be noted in connexion with Thomas Molyneux's accusation that Hooke was "the most ill-natured, conceited man in the world, hated and despised by most of the Royal Society". Strange that he should afterwards have become secretary of the Society! The truth is probably that he was impatient with fools, and ill-tempered at times, especially when he thought himself slighted. As, however, he seems to have been on good terms with most of the first-class intellects of the time —Wren, Boyle, Ent, Glisson, Petty, Aubrey and a host of others—and throughout the Diary we find him playing chess with Haak, and in the company of Abraham Hill, Daniel Whistler, Halley, and many others whose names occur over and over again as his coffee-house companions, he cannot have been so difficult as it pleased his enemies to make out. Sydenham invited Hooke to stay with him for six weeks.

If it is clear that Hooke was sharp-tempered, it is equally clear that in most cases he bore no malice. He discharged Nell Young from his service in 1673, but she continued to make his clothes and they visited one another, and although there was a quarrel in 1676, "Paid Nell for suit 6s8d besides the full of her bill 16s6d never more to do with her", within a few weeks we find "At Nell's", which thereafter occurs at intervals, as usual. Occasionally he rails at Tompion, who appears to have been slow and often behind his time, "a slug", "a rascall", but they continue to work together through the Diary, and no doubt knew one another's worth and idiosyncracies perfectly well. Even in the case of Oldenburg there is no unkind entry at his death, and Hevelius's fire is referred to sympathetically.

The people whom Hooke consistently stigmatises as rogues—Oldenburg ("a lying dog", "treacherous and a villain") and Sir John Cutler ("a villain", "a cheating knave", "Sir Stingy"—I presume that this is Sir John) appear to have done much to earn his just indignation. Oldenburg first incurs censure for not registering things brought into the Society, and there are references to his not entering experiments long before the controversy over the application of the spiral spring to the balance wheel of watches. This dispute over the balance wheel seems to have upset Hooke more than any of his other troubles. We find the entry "Saw the Lying Dog Oldenburg's *Transactions*. Resolved to quit all employments and to seek my health". (Oldenburg was responsible for the *Transactions*, which were in a sense his property, as he received all profits on the sales.) It is often held that Hooke was in the wrong, and that Oldenburg was a harmless and devoted servant of the Society, as, indeed, he induced the Society to say. It is, however, recorded of him that he "had a peculiar temper, which prevented him agreeing well with others", while at the same time he had had an early training in diplomacy which possibly rendered his approach to the truth somewhat less direct than Hooke's.

When it is remembered that Oldenburg had a financial interest in Huygens' watch, since Huygens had assigned him the patent rights, and his petition for a patent is on record, it is, perhaps, possible to believe that he was not completely unprejudiced. His statement that none of Hooke's early watches had succeeded seems to go beyond what he could have known, and it was distinctly in his own interest to make it. Hooke's account of his early

* Sir D'Arcy Power, to whom I referred this passage, very kindly tells me that there is no doubt that Hooke's headaches were due to a chronic inflammation of his frontal sinuses.

invention is true where we can check it, and it seems quite likely, in view of what we know, that he had, as he says, dropped the matter because of a very reasonable objection of his to a clause in the proposed agreement, to take it up again when he heard what Huygens had done. Thomas Thomson, in his "History of the Royal Society", refers to Hooke's character in the most censorious terms, and yet says in connexion with the balance spring, "Huygens has been considered as the author of this happy invention; but there is complete proof that Hooke anticipated him by about 14 years". Anyhow, Hooke's accusation that Oldenburg was "a traffiker in intelligence" seems absolutely justified. The Newton-Leibnitz controversy throws doubt on Oldenburg's discretion, and, in spite of his plaintive protests, when he was committed to the Tower, there are letters on record to show that he did meddle with political matters in them, as well as with scientific news. Sydenham, "universally recognised" according to the "Dictionary of National Biography", "as noble, modest and sincere" liked him as little as did Hooke, and I, for one, have the impression that he was an oblique, intriguing and toadying individual, jealous of Hooke's fame and earnings.

Sir John Cutler undoubtedly promised Hooke a yearly salary for lectures, which Hooke amply earned, and yet Sir John constantly evaded all attempts to make him pay it. He seems to have had a bad reputation. "Sir W. Petty" (a shrewd man if ever there was one) "told me that Sir J. Cutler would never pay me". Finally Hooke brought a Chancery suit against Sir John's heirs, in which he was successful. Waller quotes from a diary, no doubt the one in the British Museum, "In July 1696, being his Birth Day, his Chancery Suit for Sir John Cutler's salary, was determin'd for him, to his great satisfaction, which had made him very uneasy for several Years". It is not greatly to Hooke's discredit that he strongly resented this arrant attempt to bilk him, especially after his lectures had appeared in print with a handsome acknowledgment, in advance, of Sir John's bounty.

Another matter in which Hooke has incurred blame is the controversy with Hevelius about telescopic sights. Here there is no doubt that he was, objectively, in the right in every particular, and his estimate of the resolving power of the human eye, which he was the first to treat scientifically, is a very good one. All that he claims as advantages of telescopic sights has long since been established, and his defence against the strictures of Wallis and Molyneux is correct in manner and faultless in exposition and matter. What Waller says, that in his original "Animadversions", "he chanc'd to let slip some Expressions which, tho' possibly strictly true, could yet never be digested by Hevelius", is the most that can be urged against him. Hevelius, however, had slighted Hooke's original reasoned suggestion that he should use telescopic sights, so that a little warmth on Hooke's part is understandable. When the controversy was revived by Hevelius publishing "Annus Climactericus" in 1685, Hooke, at the Royal Society, "showed his experiments to prove the excellency of telescopic sights above plain ones, by comparing a direction by the eye with a radius of ten feet, with that of a telescope of eight inches; and it appeared to the satisfaction of all present that there was a very great advantage in the telescope".

Let us see, however, if we can find any direct contradiction of the popular view of Hooke's character in the Diary. Among other faults with which we find him charged is "extreme parsimoniousness" (Weld). On the other hand, the Diary shows him spending freely. He is always buying books, often at prices round about 25*s.*, a large sum in those days. His gifts to his niece Grace were generous: "This morning I gave Grace, Axes Stone Ring and speckled silk stockings and Ruby pendule" is but one of many entries. There are frequent records of small gifts to servants and messengers and of loans, which do not seem to have been repaid. He made extensive purchases of silks, and cloth, of wine and of brandy, and seems to have been always buying shoes. Incidentally, his use of the old term 'portoport' for port wine, of which he seems to have been fond, is much earlier than any given in the "New Oxford Dictionary". He frequented all the best taverns and coffee-houses and drank tea (the price of which was 15*s.* to 50*s.* a pound),* coffee and chocolate. He made gifts of tea and wine. One day he ate a pineapple "queen pine 2/-". He bought a hobby horse for Wren's son. He gave away copies of his books freely. These are only trifles, it may be said, but they are not rare. The general impression is that of a man who did not mind spending money on his friends and on himself—at the least the Diary makes it impossible to maintain that he was miserly.

Let us take another example. Baron Ernouf, author of the life of Denis Papin, says of his subject that he could not come to see Hooke, whom he terms "un de ces savants atrabilaires et soupçonneux dont l'espèce n'est pas perdue". Whether there was an occasion on which Hooke would not see Papin we cannot, of course, determine, but the Diary is full of entries of occasions on which he did, both when Papin visited him, and he visited Papin, so much so that under the name Papin in the index appears

* On January 16, 1679/80, Hooke "paid Chamberlain for tea, 25sh". A pound?

Passim. In July 1679, for example, they met almost daily. He seems to have done his best for the unfortunate Frenchman: "I treated with Broom and Car for Pappin's book but they agreed not". The only disparagement, if it may be so called, anywhere set down, is "Pappin ungrateful". Incidentally, a younger brother of Papin's appears, who is new to me.

The interest of the Diary for the history of science is great. It is full of observations of importance, many of which, but not all, so far as I can trace, were published later. Hooke records the hollowness of the flame of a candle: the extinction of flame by "air generated by corrosion or fermentation", "and how saturated air did the same thing", as well as many other interesting experiments on combustion: how a glass can vibrate in four, six or eight segments as shown by the movement of water in it.* We find the record of his experiment with the falling bullet, but not of his letter to Newton on the subject, though some of his important letters to Newton are noted. A curious entry refers to "the way to make aparition on the Stage by a concave cylinder", evidently a very early form of 'Pepper's ghost', and another example of Hooke's extraordinary inventiveness. Another anticipation is his observation of the curious forms sometimes shown by the rising sun—"saw the sun rise very elliptical the under side much flatter than the upper", with a drawing, and, just a year later, "the sun rose very ovall, red and indented". The earliest observations on this subject quoted by Pernter in his "Meteorologische Optik" are considerably later, namely from an unpublished manuscript of the younger Cassini, who was born in 1667.

All this time, Hooke was polishing mirrors, seeing Tompion about watches, and making instruments. There are references to the scotoscope, of which Pepys mentions an example:

"There comes also Mr. Reeve with a microscope and scotoscope. For the first I did give him £5-10, a great price, but a most curious bauble it is, and he says, as good, nay, the best he knows in England, and he makes out the best in the world. The other he gives me, and is of value; and a curious curiosity it is to look objects in a dark room with."

and to the otheometer, which I cannot find mentioned elsewhere, but which is evidently a name given to one of the many forms of barometer which Hooke invented. A matter of biographical interest is that in two separate instances there are records of Hooke giving away in the autumn copies of books which are dated the following year. There are also records of gilt copies, which must be very rare.

Reluctantly we must cease to quote from this book of manifold interests. One last note—for Mr. Dunne. On more than one occasion Hooke, who dreamt so much, speaks of prophetic dreams, as, for example, "Dreamt several things which came to pass the Day following", and again "Dream strangely fulfilled in Powis".

To produce this book has evidently been a labour of love for the editors, who have added an annotated list of the taverns and coffee-houses (some hundred and fifty of them !) mentioned by Hooke, and an excellent biographical index of getting on for two thousand names quoted in the Diary, nearly all of whom are Hooke's contemporaries. The transcription is, on the whole, excellent, but there are a few obvious errors, some of them amusing. "Eat candle, which agreed well" is not so surprising, if we suppose the word to have been "caudle"; and "cured by a felon in the neck" may well be a 'seton', if we remember the long esses.* "I wrote *myopitius gunamen*" is unlikely, if we remember that Hooke wrote a little tract called "myopibus juvamen". The "homocercle tadpoles in seed" are no doubt "homuncule", a term freely used for spermatozoa. Many of the authors and titles of foreign books and other foreign words have gone wrong: "Sutta anglicance" should clearly be "gutta anglicana": the "forces monantes" of Pardies' book should be "mouvantes" (possibly written "movantes" by Hooke) and I suspect that "Brooks' *Mathematical Jewell*" should be Blagrave's, for there is a book of this title by the latter author, of which a second version appeared in 1658, but have never heard of one by Brooks. Chizzell, in the index, should be Chiswell, who published most of the "Philosophical Collections". Slips like these, and others not quoted, are probably inevitable in a work of this length, and a few of them give the reader pleasant exercise in tracking them down. A word of praise must be spoken for the admirable illustrations, especially those of buildings planned by Hooke.

The publication of this Diary in a worthy form is an event for the history of science, and we hope that the encouragement shown by the Royal Society to its learned librarian, Mr. H. W. Robinson, upon whom the labour of the work has chiefly fallen, will incite him to further researches into the early history of the Society.

E. N. DA C. ANDRADE.

* See Waller: "Life". Hooke noted that to each figure corresponded "their particular and distinct Sounds or Notes", "the 4 and 8 were octaves and the 6 and 4 were fifths", observations which Tyndall assigns to Chladni.

* Felon was, of course, used as a term for a sore, Cf. Herrick.

"Where others love and praise my verses, still
Thy long black thumbnail marks them out for ill,
A fellon take it, or some whitflaw come
For to unslate or to untile that thumb".

Nevertheless, a deliberately produced felon is unlikely.

Characteristics of Violin Tone

THE scientific explanation of certain qualities of violin tone is still an unsolved problem of great complexity. When a copy of an old Italian violin has not the tone qualities of the original, it is very difficult to find in what details the unfaithfulness of the copy lies. No new scientific technique remains long unapplied to the problem, and the most recent results were included in Major C. E. S. Phillips' discourse bearing the above title delivered at the Royal Institution on May 31.

Some X-ray work done in America has indicated the importance of using, for the backs of violins, material in which the speed of sound is the same in all directions. A violin was shown in which the back was replaced with copper, which somewhat muted the tone, and another with a bakelite back in which the tone was almost unaffected by the change. A 'cello with a body made entirely of copper had a pleasant, woody tone.

A small microphone used as a searching device shows that the whole violin is thrown into vibration when the strings are bowed. Although it has been supposed that the chief function of the sound post is to convey vibrations from the front to the back plate, it has been found that if this post is removed and external pressure brought to bear upon the top plate above where the sound post

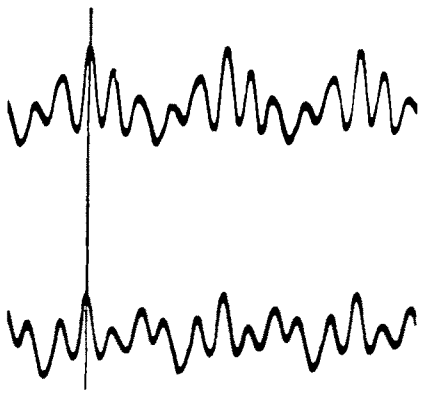

FIG. 1. Oscillograph records of tone of bowed *E* string of two Stradivari violins made in the same year, 1699. The lower record is from a 'long' pattern.

presses against it, the result is practically as good. Transillumination of two Stradivari violins shows that one with a higher arched front and back plate has been thinned more than one with a flatter front and back. The flatter top plate vibrates more easily under the pressure of the bridge than the one that is convex. The note heard on blowing across an 'f' hole of any Stradivari violin has a frequency of 256 vibrations per second.

Scientific examination of the varnish question may prevent much more of the haphazard mixing of all manner of gums and lacs dissolved in oil in attempts to make varnishes with magical qualities. Molecular size is an important factor

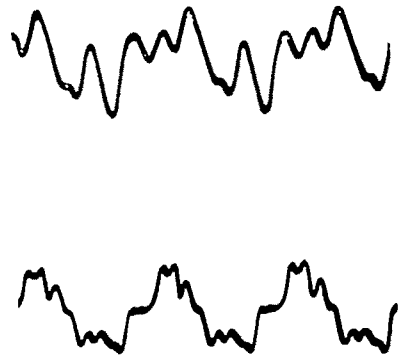

FIG. 2. Oscillograph records of tone of bowed *E* string without (above) and with mute (below)

affecting the penetration of the body of a varnish through the closely packed semi-permeable membranous cells of wood. If a varnish made by dissolving celluloid in acetone be applied to pine, the solvent will rapidly soak into the wood, leaving the celluloid behind. The early Cremona varnish as used by Stradivari or Guarneri entered the wood. Penetration would be helped by using a solvent of low surface tension on carefully dried wood, with thorough cleaning and special treatment of the surface to reduce the contact angle. The manner of application may be specially favourable under the atmospheric conditions of Italy. Terpenes obtained from the distillation of larch would have been known to Stradivari, and may have helped penetration when used to 'wet' the clean wood in a warm dry air before the application of a thin coat of an amber varnish.

An unvarnished violin soon loses some of its sonorous qualities, which are regained on varnishing. The tone of a newly varnished instrument is dull until the varnish dries thoroughly and hardens. The inside of a violin is seldom coated, and is free to absorb moisture from the air. Such absorption, which may amount to 30 gm., tends to stiffen the plate and may affect the tone. It is possible that the improvement of clearness of tone of violins with age may be explained by supposing that the small molecules of the body of the varnish slowly build themselves into larger groups, assuming a more closely-packed structure with increased rigidity. Examination by means of ultra-violet light serves to distinguish between

spirit and oil varnishes. Oil is present in all the 'Strads' so far examined by this means.

Since a violin is made up of seventy distinct parts, it would be surprising if the function of each were perfectly understood. For example, the tone of a violin without its back was found to preserve its main characteristic features. The result of the experimental removal of the sound post has been given already. The cuts and fretting of the bridge are not merely decorative. The rocking motion of the bridge in its own plane about the right foot as centre is important for fullness and quality of tone, which are but little affected when the effect of the rocking parallel to the strings is eliminated by reducing the feet to knife edges. Experiments in which the orientation of tiny steel rollers placed under the feet of the bridge was varied, were used to study this rocking motion of the bridge.

The latest attempt at the substitution of manufactured for grown fibres is in the use of artificial silk for horsehair of the violin bow. The viscose fibre retains the resin better than does the fine metal wire which is also in use for bows.

Microphone and cathode ray oscillograph have been used to obtain records of violin tone, and two examples are given in Figs. 1 and 2. During the discourse the famous 'Messie' Strad of 1760 was exhibited, and the intention of Mr. Arthur and Mr. Alfred Hill to present this unique instrument to the nation was announced. If, therefore, current scientific technique fails to solve all the problems of violin tone, future generations will have the problems handed to them in practical form.

Obituary

Prof. F. A. F. C. Went, For.Mem.R.S.

ON July 24 Prof. F. A. F. C. Went died at Wassenaar, near the Hague. He was born at Amsterdam on June 18, 1863, where he was also educated. He went to the University of Amsterdam in 1880, and worked under Hugo de Vries and also came in contact with Van 't Hoff and Van der Waals. After taking his doctorate in 1886 with a thesis entitled "De jongste toestanden der vacuolen" (The Youngest Stages of Vacuoles), Went spent some time in the laboratories of E. Strasburger (Bonn) and Ph. Van Tieghem (Paris), and then he made his first visit to Java as a fellow of the Buitenzorg Foundation.

Deeply impressed both by Nature in the tropics and also by the work and organisation of Melchior Treub, Went shortly after his return received a call to the Java sugar industry. For five years (1891–96) he was director of the West Java Sugar Experimental Station at Kagok. In this capacity, working with the late Dr. J. H. Wakker, he did very important work on the diseases of sugar cane. The results of their studies were published in their well-known book "De ziekten van het Suikerriet op Java" (The Diseases of Sugar Cane in Java, 1898). He also studied photosynthesis in the sugar cane and the formation of sucrose and other carbohydrates. Went, therefore, may be regarded as one of the pioneers of experimental stations in the Dutch East Indies, which later achieved a great reputation. His experience in Java also considerably influenced his later work. He inspired his students by his conviction that development of the Dutch Colonies should be based on scientific knowledge and a thorough investigation of the natural resources of the tropics.

Went succeeded Prof. N. W. P. Rauwenhoff in 1896 as professor of botany in the State University of Utrecht. In the first decade, he still taught the entire field of botany, but later special chairs were provided for taxonomy and plant geography, phytopathology and genetics. At first there were only a few students in biology, but gradually he attracted a large number of students. This involved much heavy teaching for a devoted and conscientious teacher such as he was, and it left him little time for his own researches. His investigations were restricted to some work on enzymes and the curious family *Podostemonaceae*. He founded, however, a school of plant physiology, which is now well-known throughout the world.

In the beginning, Went directed his attention mainly to microbiological and mycological problems. Later on, however, systematic research was directed along two lines—one of them inspired by F. F. Blackman's theory of limiting factors and the temperature-reaction velocity ratio in vital phenomena, and the other on the nature of plant movements, where Pfeffer's conceptions were fundamentally attacked. A number of papers were issued in course of time on the influence of the temperature and limiting factors on the rate of germination, growth, respiration, carbon assimilation, protoplasmic streaming and also on the perception and reaction to 'stimuli' by plants.

The name of Went, however, is most closely connected with the problem of plant movements and especially with that of tropisms and growth. The nature of the problem was formulated in Blaauw's thesis (1909). The dependence of the phototropic response on the *quantity* of light (Blaauw), analogous relations in geotropism (Mrs. Rutten-Pekelharing) and finally the correlation between quantity of light and the phototropic curvatures (Arisz, 1914), suggested an exact quantitative analysis of tropisms. These investigations received a fresh impetus from Blaauw's

theory that phototropism represents a special case of photo-growth reactions (1913). The succeeding period was devoted to exact measurements of growth, especially in *Avena* coleoptiles, as influenced by illumination and gravity (1919–26). Although a large amount of data was collected, it did not help much in visualising an internal mechanism of growth and tropisms.

The whole aspect and technique of the problem were changed, however, by the isolation of the growth substance (auxin) by Went's elder son (F. W. Went, 1927), and by his successful attempts to elaborate a physiological method of quantitative analysis of this growth substance. A large number of papers was published in the succeeding years on the relation of auxin to phototropism and geotropism, its distribution and transport, its formation in the root and its influence on the plasticity of the cell wall. Further, the chemical nature of auxin was revealed by Kögl and his collaborators (Haagen Smit, Miss Erxleben), also at Utrecht in the University Chemical Laboratory.

It was not in biology alone that Went was a man of outstanding importance. A member of the Royal Academy of Sciences, Amsterdam, since 1898, he was elected president in 1921. In this capacity he succeeded Lorentz, who strove after the War to bring together again scientific men of different nations. Went followed the example of his great predecessor with the same idealism, and finally succeeded in getting international scientific relations re-established to a large extent. Went thus played an important part in international scientific congresses.

Went was at the height of his scientific importance and international fame when he died. He retired from the chair of botany in Utrecht in July, 1934, and took an active part, until his death, in the preparations for the International Botanical Congress, of which he was president-elect. On several occasions during his life, for the last time on the occasion of his seventieth birthday, appreciation of his work was shown: in 1930 he was given the honorary degree of doctor of science of the University of Cambridge; in 1931 he was elected a foreign member of the Linnean Society of London, and in 1933 of the Royal Society. In Went we have lost a man of great qualities: his death will be deplored far beyond the boundaries of his own country.

Miss Nina F. Layard

WE regret to record the death of Nina Frances Layard, archæologist, which took place after an operation at the age of eighty-two years. She was a daughter of the Rev. C. C. Layard, rector of Combe Hay, Bath, and a niece of Sir Austen Layard, the excavator of Nineveh.

Miss Layard was not only the first woman to be elected a fellow of the Society of Antiquaries, but she was also one of the first of those women who took up seriously and earned distinction in the scientific study of archæology in the field. She was for long one of the most prominent of the students of East Anglian archæology, especially in the neighbourhood of Ipswich, holding that position almost as much by her success in stimulating the enthusiasm of others as by her own researches. These, however, especially in her studies of the industries of the palæolithic period, brought her no small reputation outside local circles, and on more than one occasion her work received the public commendation of Sir John Evans.

In addition to her finds of the palæolithic period, of which she submitted accounts to the British Association or published in the *Journal of the Royal Anthropological Institute* and other archæological publications, Miss Layard made an interesting and unusual discovery of what she held to be a prehistoric communal kitchen and a neolithic mining area, and superintended the excavation of an Anglo-Saxon cemetery, the relics from which are to be found in the Ipswich Museum. She also did much work on the investigation of remains of the Roman and medieval periods. In addition to her contributions to the *Journal of the Royal Anthropological Institute*, the *Proceedings of the Prehistoric Society of East Anglia* and other publications, Miss Layard was the author of a history of Ipswich School, of "Seventeen Suffolk Martyrs", and of two volumes of verse.

Dr. C. F. Marbut

SOIL investigators all over the world will learn with deep regret of the death of Dr. C. F. Marbut at Harbin. Early in August, he had attended the International Congress of Soil Science at Oxford, and had presided over the Section of Soil Classification and Mapping. He did not accompany the members on their excursion around Great Britain, but left instead for China, where he was to spend a year studying the soils and advising generally in regard to their mapping. Afterwards he was to go to Rome to work at the International Institute of Agriculture on the preparation of a map of the world's soils. But he was struck down by pneumonia on his voyage and died at Harbin.

Marbut began his career as a teacher in Nebraska, then became professor of geology in the Missouri University. He joined the Bureau of Chemistry and Soils of the United States Department of Agriculture at Washington and by 1912 he was appointed chief of the Division of Soil Survey: it was here that his best work was done.

Up to the time that Marbut took charge, the American soil surveys had been mainly based on the mechanical analyses of the surface soils. Marbut was essentially a field man, and discarded this analytical basis for a study of the characteristics of the soil as revealed by direct examination of the profile. This was, of course, accompanied by chemical and mechanical examinations, but the perspective was different: the interest lay in the morphology of the soil rather than in the units out of which it was made. This was in accordance with the developments of the subject being made in Russia by Glinka and others, the importance of which he recognised by translating into English the German edition

of Glinka's classical work "The Great Soil Groups of the World".

A little later Marbut had the opportunity of testing the new ideas by constructing a soil map of Africa. The actual task of making vegetation observations and collecting soil samples was carried out by Dr. Schantz in a rapid journey round the continent: the samples were very few, yet so firm was Marbut's faith in the new generalisations that he did not hesitate to construct the map, which was published in 1923 in "The Vegetation and Soils of Africa" and still serves a useful purpose.

In 1927 Marbut was in charge of the party of soil workers who travelled round the United States after the First International Soil Congress at Washington, and won great respect from his colleagues for his wide knowledge of American soils. He also visited Russia in 1930 for the second Congress, and studied the great soil groups of that country.

Marbut's great work was the organisation of the United States' soil survey, the first to be completed on modern lines. To the credit of the Department, his services were retained after he had passed the retiring age so that he might remain in charge to the end. The map was completed a few months ago.

Marbut was not merely a shrewd observer, but also a man of great personal charm, and had a singular power of capturing the affections of his colleagues. Tall, spare of build, alert and very active, with finely moulded features, he was a striking figure in the various scientific conferences he attended, and he never failed to attract and hold the attention of his audiences. His work will long survive to influence the activities of his successors.

News and Views

Norfolk Woodhenge

As stated in the preliminary announcement of the arrangements for the Norwich meeting of the British Association this year, the Norwich Research Committee has undertaken the excavation of the remarkable example of the type of monument, known to archæologists as 'Woodhenge', in the parish of Arminghall in the south-eastern outskirts of the city. The generic term 'Woodhenge' was first used by Mrs. M. E. Cunnington to describe the circle near Amesbury with wooden uprights in place of stone, which she excavated in 1926 and 1928. The Norfolk Woodhenge, which was discovered from the air in 1929, was known from air photographs to be a striking example of the type, consisting of two concentric rings, in the inner and broader of which was a gap giving access to the central space, around which were nine dark patches, presumed to be the post holes of the uprights of the circle. The completion of the work of excavation, which has been carried out under the direction of Mr. J. G. D. Clark, will enable members of the British Association, who have not previously had the opportunity, to form an idea at first hand of this striking development in the history of prehistoric monuments. In a preliminary report of the results of the excavation communicated to *The Times* of September 3, it is stated that excavation has confirmed the surface indications of a diameter for the outer circle of 262 ft. and for the central area within the smaller circle of 87 ft. The outer circle was found to be a ditch 12 ft. wide and 4 ft. 8 in. deep, the inner circle a ditch 28 ft. wide and 7 ft. 8 in. deep. As anticipated, the dark patches of the photographs are post-holes with ramps. The posts were found to consist of oak trunks some 3 ft. in diameter, set to a depth of 7 ft., after charring for preservation. It was evident that they had been dragged into position before the construction of the great inner ditch. No trace of burial was found in the enclosure, though there is evidence of burials nearby. Pottery of the Beaker type dates the structure at 1800–1500 B.C.

Cotswold Long Barrow

EXCAVATION of a long barrow near Notgrove in the Cotswolds has revealed an interior structure of a remarkable and, in certain respects, unusual character. The barrow is situated on a side road off the Cheltenham – Stow-on-the-Wold road, near the Notgrove G.W.R. station. It is being excavated by Mrs. E. M. Clifford with the assistance of a party of Cambridge students. The chamber, according to a report of the excavation which appears in *The Times* of September 2, is of the double cruciform type, which is rare in England, only about half a dozen examples being known. It has a horned entrance in dry stone walling —that is, the sides are prolonged to enclose partially a space at the entrance—and on the north side is a revetment wall in an excellent state of preservation. The south side, and also part of the north side, have been found to be enclosed by a rampart built of stone. The extent of this structure is being traced by further excavation. The most unusual feature, however, is a 'rotunda', a circular structure of large stones surrounded by a dry wall at the west end of the chambers—a form of structure of the greatest rarity, of which the purpose is unknown. These unusual features, which tempt comparisons that would be hazardous without plans and photographs, press for early publication of full details.

Celsius, Linnæus and the Centigrade Thermometer

THE history of the centigrade thermometer is discussed by Dr. N. V. Nordenmark (*Svenska Linné-Sällskap. Årsskrift*, 18, 124; 1935). He points out that the thermometer of Anders Celsius used the scale of de l'Isle, the freezing point being at 100°,

the boiling point at 0°. Celsius's diaries are preserved at the Observatory of Uppsala, and show the development of his experiments with thermometers. The centigrade scale with freezing point at zero and boiling point at 100° appeared in 1747 on a thermometer bearing the name of its maker, the optician Ekström. It was constructed by Linnæus. In 1745, Linnæus had demonstrated to the Senate of the University his new thermometer, which in a letter to Sauvage he describes: "Ego primus fui, qui parare constitui thermometra nostra, ubi functum congelationis 0 et gradus coquentis aquae 100". It is strange that this centigrade thermometer of Linnæus, soon in universal use, and known at first as "the Swedish thermometer", should ever have become associated with the name of Celsius. But perhaps it was a casual association suggested by the C. for centigrade, together with the fact that Celsius was known to have experimented with thermometers.

Public Relations Work

In a pamphlet entitled "Whither Public Relations Work?" Dr. William A. Hamor, of the Mellon Institute of Industrial Research, Pittsburgh, emphasises the need of accumulations of facts about the social structure upon which public relations work rests, in order that the principles evolved will not crumble through faulty foundation work and therefore discourage this highly important managemental aid of the future. The development of such a science as sociology, especially for application in the province of public relations, requires investigators who are willing to achieve a thoroughly disinterested point of view toward the whole life of society for the purposes of their work. It is to be hoped that the day will soon come when an organisation may be established in which far-sighted social science research of a type corresponding in importance to physical science investigation may be carried forward extensively with the co-operation of management. When sociology has reached that plane of development, much of the guess-work that is now necessary—much of that costly element of chance—will gradually be eliminated from management as a whole as well as from the direction of public relations activities.

Re-awakening of Geysir at Hawkdale, Iceland

After a sleep of nineteen years, Geysir, the hot spring in Iceland from the name of which the term 'geyser' was derived, has been awakened to renewed activity by three research workers, Trausti Einarsson, Jón Jónsson of Lang (Bath) and Gudmundur Gislason. The report of the revival of Geysir appeared in the *Morgunblad* of July 30, announcing the fact that magnificent jets were thrown up 40–50 metres high. Later, however, comes another account stating that Geysir spouted fifteen times on that day, that as of old the highest jets were delivered in the morning and about eleven o'clock at night. Eruptions are very sudden, preceded by bursts of steam, and, as it is dangerous to be near, sketches of these are more or less guess-work. Following the steam, water 'cascades' all around the crater, and the accompanying steam renders photographs or measurements useless. None of the jets has actually been measured. It was Dr. T. Einarsson who conceived the idea of awakening Geysir. He realised that the 'saucer' of the geysir was the most important factor concerned, providing a large surface of water from which heat was radiated as fast as it was supplied from below, thus preventing the accumulation of heat in the pipe below necessary to produce the outburst. Consequently a gap was made in the lip of the saucer to prevent the water spreading out. The experiment was justified, and Geysir continues its old activity. The road from Parliament Fields to Geysir, 118 kilometres in length, is to be improved, so that motor-cars may be able to undertake the journey.

Speed and Engineering

In his presidential address to the Sheffield section of the Junior Institution of Engineers, Mr. Allan J. Grant gave an interesting account of the development of speed in engineering. Up to the advent of railways, about 1830, a speed of about 30 miles an hour was the maximum. By the use of steam trains a speed of 100 miles an hour was made safe. In 1933 the motor-car *Bluebird* did 272 miles per hour. The motor-boat *Miss Britain III* recently attained a speed of 111 miles per hour. To attain this speed, 1,375 horse-power had to be transmitted through a shaft only $1\frac{1}{8}$ in. in diameter. At the outbreak of the War, the most advanced aeroplane engines developed about 100 brake horse-power, and weighed about 4 lb. per horse-power, and the average speed varied from 60 miles to 90 miles per hour. The modern 'sprint' engines run at more than 3,000 rev. per min. and weigh only $\frac{3}{8}$ lb. per b.h.p. The recent flight of Charles Ulm to Australia in 6 days 18 hours proves the capabilities of small aircraft. Jules Verne's speed in "Round the World in 80 Days" is no longer fantastic. In fact, velocities would only have to be slightly more than doubled to become 1,000 miles an hour. At this speed, it would be possible for an airman starting at the equator at sunrise and flying west to arrive in 24 hours at sunrise and have continuous sunrise all the way round. If he flew in the latitude of London he would only have to fly at 620 m.p.h. to obtain the same effect. At the present time, it would not be possible for him to carry sufficient fuel for the purpose.

Railway Electrification

In an address broadcast from Radio Paris on May 16 and published in *Le Genie Civil* for June 22, Prof. H. Parodi says that the problem of railway electrification has come to the forefront in all the countries of the world. Between 1927 and 1933 more than 6,800 miles were electrified throughout the world, more than 3,000 being in Europe. The electrification of the Paris–Orleans, Orleans–Tours and Vierzon–Brive railway is an excellent example of main-line electrification, as all the services, signals, illumination, etc., are carried out electrically. Every discovery in the realm of power-production accelerates

the spread of electrification. In electric power stations, lignite, oil, coke-oven and blast furnace gas are used as well as coal and water-power. In France, electrification is from certain points of view imperative as France has to purchase coal and oil from abroad whilst it possesses great internal water-power resources. The consumption of fuel by French railways amounts to 42 million tons, of which 30 millions has to be imported. At the present time, France utilises 8,000 million kilowatt hours of energy generated by water-power or about 20 per cent of its maximum potential water-power resources. In Italy the policy of exploiting the natural wealth of the country has been systematically pursued. More than 1,200 miles of Italian railways are electrified and 3,000 miles are in progress. Similar, but less far-reaching programmes, have been prepared and are being carried out in Switzerland, Sweden and Bavaria. The electrical machinery employed is almost entirely automatic and entails operation, maintenance and repair charges considerably lower than steam locomotives.

Centenary of the Great Western Railway

ON August 31, 1835, after an unduly protracted and very expensive Parliamentary struggle, the Royal Assent was given to the Bill authorising the construction of the railway between Bristol and London, to which two years earlier the name of the Great Western Railway had been given. Notable among British railways for many reasons, the Great Western Railway as it is to-day has a fine record of achievement, and last week the centenary of the passing of the Bill which brought it into being was commemorated in various ways. On the evening of August 30, the B.B.C. included in its programme an account of the railway and its many activities, while on August 31, *The Times* issued a Great Western Railway Centenary Number as a special supplement, of 28 full-sized pages. The forty articles in this supplement include not only sketches of the history of the line, a biography of Brunel and a review of locomotives and rolling stock, but also others dealing with co-operation in transport, speed, safety and comfort in travel and the organisation of a great railway. As is well known, when planning the Great Western line, Brunel adopted the 7 ft. or broad gauge, as compared with the 4 ft. 8½ in. or narrow gauge, as used by the Stephensons and others, and it was this that gave rise to the famous "battle of the gauges". When that battle was at its height, a Royal Commission reported that the broad gauge was superior for speed and steady running, and for the greater capacity of the engines, but as there were then 1900 miles of narrow gauge line in existence as compared with only 274 miles of broad gauge, the verdict was given in favour of the former. This and other matters are all dealt with in an interesting manner in *The Times* supplement, which will remain of permanent value to all students of transport.

International Commission of Agriculture

THE International Commission of Agriculture (International Union of Agricultural Associations) recently held its general assembly at Brussels and Gembloux (Belgium) under the chairmanship of the Marquis de Vogüé (France), president. Among the problems discussed were the organisation of agricultural production under planned economy, edible fats, limitation of pig breeding and fattening (with special reference to attempts made in Denmark and Holland). The assembly devoted special attention to the present condition of agriculture. It came to the conclusion that in spite of the fact that useful measures have been taken in several countries since 1932, conditions of agriculture have grown worse. The Commission is convinced that the two main problems to be solved in order to overcome the agricultural crisis are the wheat problem and the edible fats problem: on one hand the London Wheat Agreement (1933) should be prolonged and improved; on the other, the older civilised countries should take measures or improve the existing measures in order to prevent consumption of tropical fats and whale oil, which handicaps the normal production and consumption of butter and lard. The Commission will hold its next meeting in 1936, in Oslo. It has been decided that the twelfth International Congress of Agriculture shall take place at The Hague in 1937.

Religious Motives in Medical Biology

IN the April issue of the *Bulletin of the Institute of the History of Medicine* Dr. Walter Pagel deals successively with the doctrines of Paracelsus, Hieronymus Hirnhaim, the alchemists of the seventeenth century and their adversaries, Marcus Marci, Robert Fludd, Mersenne and Robert Boyle, to illustrate the presence of religious motives in the medical biology of the seventeenth century. Dr. Pagel first shows that to Paracelsus and his religious view is due the modern conception of disease in the establishment of three new doctrines, namely: (1) the external cause is the essence of disease; (2) the organ involved and the anatomical changes decide the nature of the disease; and (3) disease consists of a complicated disturbance of organ metabolism which secondarily reflects upon the whole system. Hirnhaim, who regarded sympathy and antipathy as fundamental phenomena, adopted a pious scepticism which was the philosophical basis of idealistic biology and pathology. On the other hand, the pious conceptions of Nature and magic in the writings of the seventeenth century alchemists led to their embarking on a course of independent empirical research, their point of view being partly due to a positive appreciation of magic as a systematic imitation of Nature by means of arbitrary variation of the conditions of natural processes. After discussing the speculative embryology of Marcus Marci and his application of the physics of light to the explanation of life according to the principles of optics, Dr. Pagel gives an account of the "Medicina Catholica" of Robert Fludd, and shows at once the similarity of his conceptions with, and the fundamental differences from, the Romantic natural philosophy during the early nineteenth century. In conclusion, consideration is given to Robert Boyle and his theory of corpuscles as a scientific explanation of the mystery of specificity, forms and final causes.

Polish Science in the Middle Ages

THE principal contribution to vol. 20 (1935) of the annual publication, *Nauka Polska* (Polish Science), is a lengthy memoir, complete with index, by Prof. Stanisław Kot entitled "Anglo-Polonica". In it the author traces the contact between Polish men of culture and their fellow workers in Great Britain. It appears that from the Middle Ages onwards quite a number of Polish theologians and some men of science and arts visited London, Oxford and Cambridge, and some made protracted stays. It was natural that educated Protestant Poles should look to England for guidance in the troublous Middle Ages for, like Britain, Poland was an asylum for the persecuted. Thus Komenský (Comenius) and other Bohemian brethren settled at Leszno. These settlers are included in the article as Polish men of science. Polish alchemists, including the famous Sedziwój (Sendivogius), met their English confrères and exchanged books and possibly recipes with one another, and also engaged in polemics. The section on alchemy is probably the most purely scientific part of Prof. Kot's article. No fresh evidence is brought to light, however, to show that the Polish alchemists were any less of charlatans than those of other countries. One point does, however, emerge, and it is that the Polish language was very widely used in Medieval Europe along the Baltic coast and in other places where it has since been displaced by German. No less than eleven important English works on science are among the twenty books reviewed in this issue of *Nauka Polska*, which can almost be considered as an Anglo-Polish number.

International Federation of Eugenic Organizations

THE report of the eleventh assembly of the International Federation of Eugenic Organizations, held in Zurich, in July 1934, under the presidency of Prof. E. Rüdin, has just been issued as a pamphlet of eighty-four pages and contains a full account of the proceedings in English and German. Prof. R. J. A. Berry opened a discussion on the diagnosis and grading of oligophrenia, to which Dr. H. O. Wildenskov of Denmark, Dr. G. Rudolf, Dr. Lothar Loeffler (Kiel) and others made contributions. Dr. Mjöen (Oslo) demonstrated his methods of testing musical ability, Prof. C. Spearman discussed the psychological basis of personality and Dr. M. Steggerda (Cold Spring Harbor) gave an account of his methods of racial psychometry in Yucatan. Dr. F. von Verschuer (Berlin) described his methods of distinguishing monozygotic from dizygotic twins, with some new facts on tuberculosis in twins. Other contributions were made on the inheritance of various ocular abnormalities, by Dr. P. J. Waardenburg, and several pedigrees of chorea were explained by Dr. G. P. Frets. Dr. Ruttke and Dr. Astel gave an account of the working of the sterilisation law in Germany. Reports of progress in eugenics were received from representatives of Norway, Denmark, Holland, Poland, Austria, Czechoslovakia and the Dutch East Indies. The proposals of the Human Heredity Committee to establish in London a Central Bureau for Human Genetics, with affiliated bureaux in various countries, are given at length, the funds required for this purpose being about £2,000 annually for four or five years. Copies of this report can be obtained, price 3*s*. 6*d*., from the Hon. Secretary, Mrs. C. B. S. Hodson, 443 Fulham Road, London, S.W.10.

American Collecting Expeditions

DURING 1935 the Academy of Natural Sciences of Philadelphia, founded in 1812, the oldest institution of its kind in America, has sponsored twenty-four expeditions for collecting and field work in thirteen foreign countries and various parts of the United States. The most thrilling of these are perhaps the African expedition headed by George Vanderbilt, which has secured gorillas and okapis for new habitat groups and large collections of other mammals, birds, reptiles, fishes and insects; Brooke Dolan's expedition to western China and eastern Tibet; R. M. de Schauensee's collection of birds, fishes and orchids from the central highlands of Guatemala, and aquatic life from Lake Atitlan, 5,000 feet above sea-level. In Siam this collector-naturalist, after his third expedition there, organised a permanent field staff with headquarters in Bangkok which continues to gather much interesting material; and in Siberia Dr. E. B. Howard is searching for fossil remains of man which would link up with the earliest human arrivals on the American Continent. In America, expeditions are at work on the high plateau of Central Mexico, in the mountains of Panama, Cuba and the West Indies, Alaska, Wyoming, Bolivia, New Mexico and Louisiana.

The Strangeways Laboratory

IN their report for 1934, the trustees direct attention to the amount of work carried out at the Strangeways Research Laboratory, Cambridge, at very small expense, and appeal for further support. The increase in subscriptions and endowment has not kept pace with the increase in the work and the growing demand for funds to finance new work. The appeal is not for an extravagant scheme of expansion, since one of the advantages of the laboratory is that it is housed in a small building where the staff can work as a team with constant opportunities for discussion and co-operation, but for a sufficient income to enable the director, Dr. Honor Fell, and her colleagues to carry out their work this year with the apparatus and materials they need, and to plan next year's work with confidence that the funds required will be available. The trustees cannot count as a permanent source of income the grants from the Royal Society and Medical Research Council which have been provided for several years. As regards research work, steady progress has been made in fields which lie within the overlapping borders of general biology and medicine. The cultivation of living embryonic tissues in artificial media helps to reveal the factors which control normal growth, both of the individual cells and of the different tissues in relation to each

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Supplement to "NATURE"

No. 3436 SATURDAY, SEPTEMBER 7, 1935 Vol. 136

Form, Drift, and Rhythm of the Continents*

By Prof. W. W. Watts, F.R.S.

President of the British Association

IT is now sixty-seven years since the British Association enjoyed the hospitality of the city of Norwich, a privilege which is being renewed under the most happy auspices.

At that meeting we find the scientific community was particularly interested in underground temperatures and tidal phenomena, in the application of the spectroscope to celestial objects, and in the discovery of the oldest Cambrian fossils and the earliest fossil mammals then known. Many papers were read on local natural history, including those on Norfolk farming and the drainage of the county and of the Fens.

In his address at the meeting the president, Sir Joseph D. Hooker, made special reference to the work of Charles Darwin: not to the "Origin of Species" which had been acrimoniously discussed by the Association on previous occasions, and notably at Oxford in 1860, but to some of the work that followed.

It should be remembered that Hooker was one of the three scientific men, representing botany, zoology and geology, whom Darwin had selected as judges with whose opinion on the soundness of his theory of the origin of species he would be content. The others were Huxley and Lyell; and of the three Lyell was the hardest to convince, chiefly because the record of life in the past then furnished by the rocks was manifestly so incomplete and unsatisfactory that its evidence was insufficient to warrant a definite verdict.

UNIFORMITARIANISM

Lyell had set out to "treat of such features of the economy of existing nature, animate and inanimate, as are illustrative of geology", and to make "an investigation of the permanent effects of causes now in action which may serve as records to after ages of the present condition of the earth and its inhabitants". By laborious study of the work of others, and by his own extensive travel and research, he had been able to enunciate, for the inorganic world, the principle of uniformitarianism, which in its original form we owe to Hutton. This principle involved that the history revealed by the rocks should be read as the effect of the slow but continuous operation of causes, most of them small, such as could be seen in action in some part or other of the world to-day. This was set in opposition to the opinion of the older geologists, who had postulated a succession of catastrophes which, by flood, fire and convulsion, had periodically wrecked the world and destroyed its inhabitants; each catastrophe necessitating a new creation to provide the succession of life on the earth as it then was known.

But in the organic world, Lyell, like Hutton, had failed to detect any analogous principle, and, as he rejected all the theories of transmutation of species then in vogue, he had to accept their absolute fixity; and to suppose that, as species became extinct one after another, replacement by special creations followed. Yet the reading to-day of the chapters devoted to this branch in the earlier editions of Lyell's great work produces the haunting feeling that a better explanation had only just eluded him. It was the story revealed in Lyell's work, Darwin tells us, the new conception that the earth had been in existence for vast æons of time, the proof that it had been continuously peopled by animals and plants, and that these had steadfastly advanced and improved throughout that time, which showed him the necessity for an explanation of the progression of life, and gave him the first hints of his theory.

* PRESIDENTIAL ADDRESS DELIVERED AT NORWICH ON SEPTEMBER 4, 1935.

When he had enunciated this, he was enabled to repay his master with the principle of organic evolution, which brought changes in the animate world into harmony with those of the inanimate.

His "Antiquity of Man" shows that by 1863 Lyell had become a convert, and he afterwards rewrote much of the second volume of his "Principles" accepting the new point of view. This change earned from Hooker a testimonial in the 1868 address which, if not unique, must certainly be one of the most magnificent ever awarded to a scientific work:

"I know no brighter example of heroism, of its kind, than this, of an author thus abandoning, late in life, a theory which he had regarded as one of the foundation stones of a work that had given him the highest position attainable amongst contemporary scientific writers. Well may he be proud of a superstructure, raised on the foundation of an insecure doctrine, when he finds that he can underpin it and substitute a new foundation: and, after all is finished, survey his edifice, not only more secure, but more harmonious in proportions than before."

Although infinitely richer than when Darwin wrote, the geological record still is, and must from its very nature remain, imperfect Every major group of animal life but the vertebrates is represented in the Cambrian fauna, and the scant relics that have been recovered from earlier rocks give very little idea of what had gone before, and no evidence whatever as to the beginnings of life. But, from Cambrian time onward the chain of life is continuous and unbroken. Type after type has arisen, flourished, and attained dominion Some of them have met extinction in the heyday of their development; others have slowly dwindled away; others, again, have not finished their downhill journey, or are still advancing to their climax.

Study of the succession of rocks and the organisms contained in them, in every case in which evidence is sufficiently abundant and particularly among the vertebrates and in the later stages of geological history, has now revealed that the great majority of species show close affinities with those which preceded and with those which followed them; that, indeed, they have been derived from their predecessors and gave origin to their successors. We may now fairly claim that palæontology has lifted the theory of evolution of organisms from the limbo of hypothesis into a fact completely demonstrated by the integral chain of life which links the animals and plants of to-day with the earliest of their forerunners of the most remote past.

Further, the rocks themselves yield proof of the geographical changes undergone by the earth during its physical history; and indicate with perfect clearness that these changes have been so closely attendant on variation in life, and the incoming of new species, that it is impossible to deny a relation of cause and effect.

Indeed, when we realise the delicate adjustment of all life to the four elements of the ancients which environ it, air, water, earth and fire; to their composition, interrelationships and circulation; it is perhaps one of the most remarkable facts established by geology that, in spite of the physical changes which we know to have occurred, the chain of life has never snapped in all the hundreds of millions of years through which its history has been traced.

Rhythm of Sea and Land

The physical changes with which Lyell and his successors were most closely concerned were, first, the formation of stratified rocks on horizontal sea-floors, situated in what is now often the interior of continents, far removed from the oceans of the present day, and thus indicating important and repeated changes in the position of land and water; and, secondly, the deformation of these flat deposits until they were rucked and ridged to build the mountain ranges.

Before and since Lyell's time, geologists have devoted themselves to working out the exact and detailed succession of these stratified rocks, translating their sequence into history and their characters into terms of geography; the succession of physical conditions prevailing at the time of their formation. Further, although animals and plants migrate from place to place, the time occupied by the migrations of suitable forms is so negligible when compared with the length of the chapters of geological history that their fossil remains have proved to be the best means for correlating strata over broad stretches of the earth's surface This correlation has converted the fragments of local history thus revealed into at least the outlines of the geological story of the world.

It was not until 1885, however, that the accumulation of data of this type was sufficient to enable the great geologist, Suess, an Austrian, but born in Great Britain, to assemble and correlate them, and to deduce from them further principles which have been the mainstay and inspiration of his successors. We owe to Hertha Sollas and her father the rendering of this great work, "The Face of the Earth", into English; and to Emmanuel de Margerie and his colleagues a French translation enriched with a magnificent series of maps and sections such as could only have been brought together by one with the most remarkable bibliographic knowledge: a veritable recension of the original.

The nature and associations and the distribution in time and space of modern changes in the relative levels of land and sea, as detected at sea-margins and by altitude survey, and of older changes betrayed by such evidence as submerged forests and raised beaches, had convinced geologists that the unstable element was not the fickle and mobile sea, but the solid if elastic earth-crust. They naturally applied the same explanation to those encroachments of the sea in the past which had resulted in the formation of our stratified rocks. But while some investigators were content with one form of movement—that due to lateral pressure—to explain both the formation of mountains and the rise and fall of the land, others called in a different cause for the latter. Without entering into a discussion of causes, it may be well for us to distinguish the orogenic or mountain-forming from the epeirogenic or continental movement.

The evidence collected by Suess proved that these last great land and sea changes had occurred simultaneously over whole continents or even wider regions. Such great submergences as those to which the Cambrian Rocks, the Oxford Clay, and the Chalk are due were of this character; while, in between, there came times of broad expansions of continental land and regressions of the sea. These changes were in his view on far too grand a scale to be compared with, or explained by, the trivial upheavals and depressions of land margins of the present day, which he showed could mostly be correlated with volcanoes or earthquakes, or with such incidents as the imposition or relief of ice-sheets on an elastic crust in connexion with glacial conditions.

It became necessary for him to replace or supplement oscillations of the earth-crust by a world-wide periodic ebb and flow of the oceans, to and from the continents; positive movements of transgression carrying the sea and its deposits over the lands, drowning them and their features under tens or hundreds of fathoms of water; and negative movements or regressions when the oceans retreated to the deeps, leaving the continents bare or encrusted with recently formed sediments.

Although the facts cried out for this generalisation, Suess was at a loss to supply any mechanism competent to produce the wonderful rhythm. The problem was difficult because a liquid must maintain a horizontal, that is, an equipotential, surface. It was manifestly impossible to withdraw from the earth, and later to replace upon it, the vast quantity of water that would be required; and, though a shifted water-level, or even a varied water-surface relative to the continents, might be caused by polar ice-caps, by redistribution of the continents carrying their local effects on gravitation, by variations in the rate of the earth's rotation, or other far-reaching causes, none of these would supply an explanation that fitted all the facts. Regressions of the sea could be to some extent explained if Suess's main postulate, that the great ocean basins had been slowly sinking throughout geological time, were granted. But this explanation only rendered more impotent the raising of ocean levels by deposits of sediment, and this was almost the only valid cause for transgressions that he had been able to suggest.

Further, it is not possible to ignore the definite relationship that exists between the pulsation of the oceans and the raising of mountains by lateral or tangential stress. Periods of positive movement or advance of the seas were times of comparative tranquillity, when tangential pressure was in abeyance. Periods of negative movement and retreat were invariably marked by the operation of great stresses by which the earth's face was ridged and wrinkled in the throes of mountain-birth.

Mountain Ranges

The theory that continuous cooling and shrinkage of the interior of the earth afforded an explanation of mountain ranges and other rugosities on its surface was a legacy from the nebular hypothesis. In spite of the homely simile of a shrivelling apple, this explanation has never received a very enthusiastic welcome from geologists, though, in default of other resources, they had to make use of it. As knowledge has grown, the difficulties have become insurmountable to them.

First, there is its inadequacy to explain the vast amount of lateral movement required to account for the greater mountain ranges; their rocks, originally spread over a wider area, having been folded and crushed into a narrower width. The shortening of the earth-crust thus effected has been estimated in the case of the Rocky Mountains at 29 miles, of the Himalayas at 62, the Alps at 76, and the Appalachians at the large figure of 200 miles.

Then there is the periodicity of mountain growth. The great epochs of mountain building, such as the Caledonian, to which the chief Scottish and Welsh mountains are due, the Hercynian, responsible for the Pennine and South Wales, and the Alpine, which gave us "the wooded, dim, blue goodness of the Weald", were associated with vast continental development; and each was separated from the next by a period of relative inactivity lasting dozens of millions of years.

Further, there is the fact that the vigour of mountain building, of volcanoes, and of other manifestations of unrest, has shown no sign of

senility or lack of energy. The geologically recent Alpine-Himalayan range is as great, as lofty, and as complicated in structure as were any of its precursors. The active volcanoes of Kilauea, Krakatao, or St. Pierre, and those recently extinct in northern Ireland and the Scottish Isles, were as violent and efficient as any of those of the Palæozoic era. The earth is 'a lady of a certain age', but she has contrived to preserve her youth and energy as well as her beauty.

Age of the Earth

It was when Lord Kelvin's dictum struck from geology its grandest conception, time, that it became vital to re-examine the position. He had demonstrated that, if the earth had been continuously cooling down at its present rate, its surface must have been too hot for the existence of life upon it a limited number of million years ago. The concept of geological time, indicated by Hutton in his famous saying that in this inquiry "we find no vestige of a beginning—no prospect of an end", had been confirmed by data accumulated through the painstaking researches of a host of competent and devoted observers all over the world. To them, familiar with the tremendous changes, organic and inorganic, that the earth had passed through since Cambrian time, it was wholly impossible to compress the life-story of the earth, or the history of life upon it, into a paltry twenty or thirty million years. The slow growth and slow decay of mountain range after mountain range, each built out of, and in some cases upon, the ruins of its predecessor; the chain of slowly evolving organisms, vast in numbers and infinite in variety; told plainly of long æons of time. The duration of these æons can be dimly realised when it is recalled that, within a small fraction of the latest of them, man, with the most primitive of implements and the most rudimentary culture, has succeeded in penetrating to the uttermost corners of the world, and developed his innumerable languages and civilisations.

Huxley took up the challenge in his address to the Geological Society in 1869, and asked the pertinent question, "but is the earth nothing but a cooling mass 'like a hot water jar such as is used in carriages' or 'a globe of sandstone'?" He was able to point out at least some agencies which might regenerate the earth's heat or delay its loss.

So it is only fitting that the great physicist, who imposed a narrow limit to geological time, should have prepared the way for those who have proved that the earth possesses in its radioactive substances a 'hidden reserve' capable of supplying a continuous recrudescence of the energy wasted by radiation, thus lengthening out the time required to complete its total loss. These later physicists have given us time without stint; and, though this time is the merest fraction of that envisaged by cosmogonists and astronomers, we are now so much richer than our original estimates that we are embarrassed by the wealth poured into our hands. So far from the last century's urge to 'hurry up our phenomena', we are almost at a loss for phenomena enough to fill up the time.

The far-sighted genius of Lord Rutherford and Lord Rayleigh first saw the bearing of the rate of disintegration of radioactive substances in the minerals of rocks on the age of the parts of the earth-crust built of them. The extension and supplementing of this work, by Joly, Holmes and others, has now enabled us to look to the disintegration of uranium, thorium and potassium, as the most promising of many methods that have been used in the endeavour to ascertain the age of those parts of the earth-crust that are accessible to observation. These methods also promise a means of dating the geological succession of Eras and Periods in terms of millions if not hundreds of thousands of years.

The Earth Pulse

The decline and early death to which Lord Kelvin's dictum had condemned the earth, according so little with the vigour displayed in its geological story, is now transformed into a history of prolonged though not perennial youth. It was for Joly, of whose work the extent, variety and fruitfulness are scarcely yet fully appreciated, to take the next step and see in the release of radioactive energy a mechanism which could drive the pulse that geologists had so long felt, and that Suess had so brilliantly diagnosed. As Darwin found the missing word for Lyell, so Joly in his theory of thermal cycles has indicated the direction of search for a mechanism to actuate the rhythm of Suess.

In Joly's conception, the running down of the earth's energy, though a continuous process, was, through the intervention of radioactivity, converted into a series of cycles, during each of which relative movements of sea and land must occur; downward movements of the continents, associated with positive encroachments of the sea; upward movements, with retreat of the sea, the formation of wide land masses, and the ridging of strata to form mountain ranges. Thus he forged a link that could unite the continental or epeirogenic movement with orogenic or mountain movement.

The visible parts of mountains and continents, as well as their lower and hidden portions, or 'roots', are made of comparatively light rocks. In order to stand up as they do, their roots must be

embedded in denser matter, in which they 'float' like icebergs in water. A far larger mass must exist below than is visible above, and the bigger the upstanding part the bigger the submerged root. Over the larger area of the ocean floor, on the other hand; the thickness of material of low density must be very slight, and the denser layer must come close to the surface.

Thermal Cycles

The study of earthquakes, to which the Seismology Committee of the British Association has made outstanding contributions, has yielded, from the times taken in transmission of vibrations through the earth, the best information as to the nature and state of the interior. It has proved that the dense layer is solid at the present time. It is probably no coincidence that the earth is also but just recovering from what is possibly the greatest period of mountain building, if not the greatest negative movement of ocean retreat, that it has ever experienced.

But solidity cannot be the permanent condition of the substratum. Heat is generated in it by its own radioactivity, but, according to the terms of the hypothesis, cannot escape, in consequence of the higher temperature generated in the continental rocks which cover it. It is therefore retained in the substratum and stored as latent heat of liquefaction, so that, within a period which has been calculated approximately in millions of years, complete melting of the sub-crust must ensue.

The resulting expansion of the liquefied stratum will have at least two effects of great importance to us. In the first place, the unexpanded superficial layers will be too small to fit the swelling interior. They will, therefore, suffer tension, greater on the ocean floor than on land, and cracking and rifting will occur, with intrusion and extrusion of molten rock. In the second place the continental masses, now truly floating in a substratum which has become fluid and less dense than before, will sink deeper into it, suffering displacement along the rift cracks or other planes of dislocation. As a result the ocean waters, unchanged in volume, must encroach on the edges of the continents, and spread farther and farther over their surfaces.

Thus we have the mechanism which Suess vainly sought, causing positive movements of the oceans, their waters spreading over wide stretches of what was formerly continental land, and laying down as sediment upon it the marine stratified rocks which are our chief witness of the rhythmic advances of the sea.

This condition, however, cannot be permanent, for by convection of the fluid basic substratum, supplemented by the influence of tides within it, and the slow westward tidal drag of the continental masses towards and over what had been ocean floor, there will now be dissipation of its heat, mainly into the ocean waters, at a rate much faster than it has been or could be accumulated. Resolidification ensues, and again there are two main consequences. First, the stratum embedding their roots having now become more dense, the continental masses rise, and as they do so the ocean waters retreat from their margins and epicontinental seas, leaving bare as new land, made of the recently deposited sediments, the areas previously drowned. Secondly, the expanded crust, left insufficiently supported by the withdrawal of shrunken substratum, will suffer from severe tangential stress, and, on yielding, will wrinkle like the skin of a withering apple. The wrinkles will be mountain ranges, formed along lines of weakness such as those at continental margins ; and they will be piled up and elevated, to suffer from the intense erosion due to water action upon their exposed and upraised rocks.

In this, again, we have a mechanism which supplies what was needed by Suess, and one, moreover, which secures the required relationship between continental and mountain movement, between the broader extensions of continental land and the growth of mountains with their volcanoes and earthquakes and the other concomitants of lateral thrust.

Thus a thermal cycle may run its full course from the solid substratum, through a period of liquefaction accompanied by crustal tension, back to solidification and an era of lateral stress : and the stage is set for a new cycle.

Prof. Arthur Holmes, in checking Joly's calculations, has concluded that the length of the cycles in a basic rock substratum should occupy 25–40 million years, a period much too short to fit the major periods of mountain movement, as determined by him from the radioactivity of minerals contained in the rocks. On this evidence the Alpine movement should date back 20–60 millions of years ago, the Hercynian 200–250 millions, and the Caledonian 350–375 million years.

In a preliminary attempt to modify Joly's hypothesis, Holmes postulated the occurrence of similar, but longer cycles (magmatic cycles) in a denser, ultra-basic layer underlying the basic one, the rhythm of which would be nearer to 150 million years. The shorter cycles due to the basic layer are held in part responsible for periods of minor disturbance, and also to account for the individual variations in effect, duration and intensity of the larger ones. Each of the later movements has also evidently been limited and conditioned by the results of foregoing ones, and especially by areas of

fracture and weakness on one hand, and by large stable masses composed of rocks intensely consolidated, or already closely packed, on the other.

More recently, Holmes has developed the possibility that the loss of heat is mainly due to convection in the liquid substrata, and that convection is the leading cause of the drifting and other movements of the crust, and the disturbances that have occurred in it. He says:

"Although the hypothesis involving sub-crustal convection currents cannot be regarded as established, it is encouraging to find that it is consistent with a wide range of geological and geophysical data. Moreover, it is by no means independent of the best features of the other hypotheses. It requires the local operation of thermal cycles within the crust, and it necessarily involves contraction in regions where crustal cooling takes place. It is sufficiently complex to match the astonishing complexities of geological history, and sufficiently startling to stimulate research in many directions".

The phenomena are difficult to disentangle as the number of operating causes has been so great and many of them are not fully understood. But, underlying them all there is unquestionably the pulse within pulse which Suess saw, and of which Joly pointed the way to explanation.

The view at which we have arrived is neither strictly uniformitarian nor strictly catastrophic, but takes the best from each hypothesis. As Lyell showed, most of the phenomena of geology can be matched somewhere and sometime on the earth of to-day; but it would appear that they have varied in place, intensity, phase and time. And, as Lyell was driven to accept *evolution* to explain the history of life on the earth, so must we employ the same word to express the life-processes of the earth itself, as was suggested by Huxley in 1869 and strongly advocated by Sollas in 1883.

The Atlantic and Pacific Oceans

The contrast in outline and structure between the Atlantic and Pacific Oceans had long been noted when Suess formulated and used the differences as the basis of his classification.

The Pacific is bounded everywhere by steep slopes, rising abruptly from profound ocean depths to lofty lands crowned with mountain ranges, parallel to its shores and surrounding its whole area. On the American side the coast range is continued by the Andes. On the Asiatic side chains of mountainous peninsulas and islands, separated from the continent by shallow inland seas, extend in festoons from Kamchatka and Japan to the East Indies, eastern Australia and New Zealand. This mountain ring, as Charles Lapworth said, "is ablaze with volcanoes and creeping with earthquakes", testifying that it has been recently formed and is still unfinished.

The Atlantic Ocean, on the other hand, is not bordered with continuous ranges, but breaks across them all: the Scottish and Welsh ranges, the Armorican range, the continuation of the Pyrenees and Atlas; and, on the American side, the uplands of Labrador, Newfoundland and the eastern States, and the hill ranges of Guiana and Brazil. The Atlantic is in disconformity with the grain of the land, while the Pacific conforms with it. The Pacific has the rock-folds of its ranges breaking like ocean waves towards it as though the land were being driven by pressure to advance upon it, while the Atlantic recalls the effects of fracture under tension.

The middle and southern edges of the Atlantic, however, agree to some extent with the Pacific type. The Caribbean Sea, with the Antilles and the rest of its border girdle, recalls the similar structure of the Mediterranean, as it stretches eastwards, with breaks, to the East Indian Archipelago; while the Andes are continued to Antarctica in a sweeping curve of islands. The rest of the Indian Ocean is of Atlantic type, as seen in the shores of eastern Africa and western Australia.

Continental Drift

Another feature of the Atlantic is the parallelism of much of its eastern and western coasts, the meaning of which has often attracted the speculations of geologists and geographers. With a little stretch of the imagination, and some ingenuity and elasticity of adjustment, plans or maps of the opposite sides may be fitted fairly closely, particularly if we plot and assemble the real edges of the continents, the steep slopes which divide the 'shelves' on which they stand from the ocean depths. This has suggested the possibility that the two sides may once have been united, and have since broken and drifted apart until they are now separated by the ocean.

This view, outlined by others, has been emphasised by Wegener and dealt with by him in full detail in his work on "The Origin of Continents and Oceans", and it now plays a leading part in what is known as the Wegener theory of continental drift. The hypothesis is supported by the close resemblances in the rocks and fossils of many ages in western Europe and Britain to those of eastern North America; by community of the structures by which these rocks are affected; and

by the strong likeness exhibited by the living animals and plants on the two sides, so that they can only be referred to a single biological and distributional unit, the Palæarctic region.

The hypothesis, however, did not stop at this; and in the South Atlantic and certain other areas Wegener and his followers have also given good reasons for believing that continental masses, once continuous, have drifted apart.

Broad areas in southern Africa are built of rocks known as the Karroo Formation, of which the lower part, of late Carboniferous age, is characterised especially by species of the strange fern-like fossil plants *Glossopteris* and *Gangamopteris*. Associated with them are peculiar groups of fossil shells and fossil amphibia and reptiles. Similar rocks, with similar associations and contents, in Peninsular India have been named the Gondwana Formation. Comparable formations also occupy large regions in Australia, Tasmania and New Zealand, in Madagascar, in the Falkland Islands and Brazil, and in Antarctica.

The correspondence between these areas is so close that Suess supposed they must at that date have been connected together by lands, now sunk beneath the sea, and he named the continent thus formed Gondwanaland after the Indian occurrences. The break-up of this land can be followed from a study of the rocks, and it was a slow process, its steps occupying much of Mesozoic time. Dr. A. L. du Toit's comparison of South African rocks with those of Brazil and elsewhere in South America favours even a closer union than this between the units now scattered.

One of the most remarkable features shown by these rocks in all the areas mentioned, but to varying extents, is the presence of conglomerates made of far-travelled boulders, scratched like those borne by the modern ice-sheets of Greenland and the Antarctic, associated with other deposits of a glacial nature, and often resting upon typical glaciated surfaces. There is no possible escape from the conclusion that these areas, now situated in or near the tropics, suffered an intense glaciation. This was not a case of mere alpine glaciers, for the land was of low relief and not far removed from sea-level, but of extensive ice-sheets on a far larger scale than the glaciation of the northern parts of the New and Old Worlds in the Pleistocene Ice Age. I have never seen any geological evidence more impressive or convincing than that displayed at Nooitgedacht, near Kimberley; while the illustrations and other evidence published by David and Howchin from Australia are equally striking.

Du Toit's work on these glacial deposits brings out two remarkable facts; first, that the movement of the ice was southerly, pole-ward and away from the equator, the opposite to what would be expected and to the direction of the Pleistocene ice-movement; secondly, that the ice in Natal invaded the land from what is now sea to the north-east.

When it is realised that at this period there is no evidence of glacial action in northern Europe or America, but a climate in which grew the vegetation that formed the coal seams of our Coal Measures, it is clear that we are not dealing with any general refrigeration of the globe, even if that would produce such widespread glaciation: we are face to face with a special glaciation of Gondwanaland.

On both sides of the Atlantic these glacial episodes in Carboniferous times were followed by dry and desert climates in Triassic time, and these by violent volcanic outbursts. Nor are the rocks alike only in mode of formation: the structures by which they are traversed correspond; while even in details there is remarkable agreement, as in the peculiar manganese deposits, and the occurrence of diamonds in 'pipes' of igneous rock, both east and west of the Ocean.

Rather than face the difficulties presented by the subsidence of lands connecting the severed portions of Gondwanaland, as pictured by Suess, Wegener has preferred—and in this he is supported by Du Toit and many other geologists—to bring into contact these severed parts, which could be fitted together as nearly as might be expected, considering the dates of severance. Du Toit's map of the period places South America to the west and south of South Africa, Madagascar and India to the east, Antarctica to the south, and Australia farther to the south-east. Such a grouping would form a continent much less wide in extent than that envisaged by Suess, and would offer some explanation of the more remarkable features of the glaciation in the several areas, as well as the problems of the rocks, fossils and structures involved.

In its application to the geology of Gondwanaland the modified hypothesis of Wegener cuts a Gordian knot; but it still leaves a great climatal difficulty, unless we take his further step and conceive that at this date the terrestrial south pole was situated within Gondwanaland. No shift in the axis on which the earth rotates would, of course, be possible, nor is it postulated: only a drifting at that date of continental land across the pole.

If a hypothesis of drift be admitted for Gondwanaland, it would be illogical to deny its application to other regions, including the north Atlantic. I have already mentioned some facts in its favour. Others are the resemblances of all sedimentary rocks on the two sides from the Cambrian to the

Ordovician, and from the Devonian to the Trias; the links between the structures of the land, as, for example, between Ireland and Newfoundland; and the instance given by Prof. E. B. Bailey in his address to Section C in 1928. As Bailey then pointed out, the great Caledonian range which crosses Scotland, northern England and Wales from north-east to south-west on its course from Scandinavia is affected and displaced by the east to west Armorican (Hercynian) chain extending across from Brittany to South Wales. "The crossing of the chains, begun in the British Isles, is completed in New England"; and from here the Armorican structure continues its westerly course. This is where it should cross if the continent of North America were brought back across the Atlantic and placed in the position which, according to Wegener, it would fit into in the European coast! Can the Pilgrim Fathers have ever dreamed of such a link between the Old England and the New?

The hypothesis of continental drift gave rich promise of solving so many difficult problems that it was hailed by many classes of investigators almost as a panacea. Geographers have seen in it an explanation of the forms of continents and the position of peninsulas, islands and mountains; meteorologists have found it the solution of some of the problems of past climates and their anomalies of distribution over the world; biologists hope to get help with the intense complexities in the distribution of forms of life and many strange facts in migration, and palæontologists with similar difficulties among the ancient faunas and floras as revealed by their fossil remains; geodesists have welcomed escape from the rising and sinking of the crust, so difficult to reconcile with the demands of isostatic equilibrium; and it has been already stated that drift forms a vital factor in Joly's thermal cycles.

But there has been no lack of criticism in all these directions. It has been assailed on one hand for the detail attempted in its geographical restorations, and on the other hand for its vagueness. Prof. Schuchert quotes Termier as saying that it is "a beautiful dream, the dream of a great poet. One tries to embrace it, and finds that he has in his arms but a little vapour or smoke: it is at the same time alluring and intangible". It has been objected that "no plausible explanation of the mechanics involved has been offered"; that the continental connexions postulated present by no means so close a match, when fitted together, as has been claimed, in the structure or the nature of either igneous or sedimentary rocks; that there is good evidence of extensive vertical movements in recent earthquakes, in the accumulation of tremendous thicknesses of sediment indicative of shallow-water from base to summit, and in the growth of coral reefs; that Central America and the Mediterranean are a difficult obstacle; and that the known distribution of the Karroo fossil reptiles is not by any means what the hypothesis demands.

If the idea of drift be accepted, it cannot be regarded as a royal road out of all our difficulties, nor can it be the only form of earth-movement to be reckoned with. The late J. W. Gregory, whose life was sacrificed to geological discovery, studied exhaustively the geological history of the Atlantic and Pacific Oceans, both as revealed by the sedimentary rocks and fossils on their borders, and by the distribution of life to-day. He found that, according to our present knowledge, in the two oceans, facilities for migration have fluctuated from time to time, periods of great community of organisms alternating with periods of diversity. Again, at some times connexion seems to have been established north of the equator, at others to the south; and we cannot ignore the possibility of migration across polar lands or seas when terrestrial climates have differed from the present. The facts of life distribution are far too complex to be explained by any single period of connexion followed by a definite breaking apart, even if that took place by stages. Mrs. Reid, too, has pointed out that resemblances between the Tertiary floras of America and Europe actually increased at the time when the Atlantic should have been widening. Unless continental drift has been a more complicated process than anyone has yet conceived, it seems impossible to escape from some form of the 'land bridges' of the older naturalists:

> "Air-roads over islands lost—
> Ages since 'neath Ocean lost—"

We have no right to expect greater simplicity in the life of a planet than in that of an organism.

As the question of drift must in the last appeal be one of fact, it is not unnaturally expected that the real answer will come from measurements of longitude and latitude with greater exactness and over periods longer than has yet been possible. None of the measurements hitherto made has indicated variations greater than the limits of errors of observation. Two things, however, may militate against a definite answer from this source. Many parts of the crust, such as the shield-like masses of Archæan rock, may have completed their movement, or be now moving so slowly that the movement cannot be measured. Careful selection of locality is essential, and at present we have little guidance. Also, as the displacement of crust must be dependent on the condition of its substratum, it will be a periodic phenomenon and the

rate of movement may vary much in time. According to the theory of thermal cycles the sub-crust is at present solid, and may not permit of drift. Drift, according to Joly and Holmes, is a cyclical phenomenon; if present-day observations were to give a negative result they would not necessarily disprove it.

The occurrence of recumbent rock-folds, and nearly horizontal slides or 'nappes' in mountain regions, gives positive proof that parts of the upper earth-crust have moved over the lower. In the North-west Highlands of Scotland, a sliding of at least ten miles was proved by Peach and Horne, and in Scandinavia it amounts to sixty miles. For mountain packing as a whole the figures already given are far larger, while in Asia, Argand has stated that packing of more than 2,000 miles has occurred. Thus, when all is said and done, movements on a colossal scale are established facts, and the question of the future is how far we shall accept the scheme of drift due to Wegener, or one or other of the modifications of it. It is for us to watch and test all the data under our own observation, feeling sure that we shall have to adapt to our own case Galileo's words "e pur si muove".

Rock Folding and Mountain Birth

Ever since it was realised that the inclination and folding of rocks must be attributed to lateral or tangential stress and not solely to uplift, shrinkage of the interior of the earth from its crust has been accepted as the prime mover, and whichever of the current theories we adopt, we cannot deny the efficacy of so powerful a cause.

The general course of events in the formation of a mountain range is fairly well known: the slow sinking of a downfold in the crust during long ages; the filling of this with sediment *pari passu* with the sinking, and associated softening of the sub-crust due to accumulated heat; the oncoming of lateral pressure causing wave-like folds in the sediments and the base on which they rest; the crushing of folds together until, like water waves, they bend over and break by over-driving from above or, it may be, under-driving from below; fracture of the compressed folds and the travelling forward for great distances of slivers or 'nappes' of rock, generally of small relative thickness but of great length and breadth, and sliding upon floors of crushed rock; the outpouring and intrusion of igneous rocks, lubricating contacts and complicating the loading of the sediments; metamorphism of many of the rocks by crystallisation at elevated temperatures and under stress, with the development of a new and elaborate system of planes of re-orientation and movement; and elevation of the whole, either independently or by thickening with compression and piling up to bring about a fresh equilibrium.

Such a course of events would be brought about by lateral pressure developed during the consolidation phase of each of the thermal or magmatic cycles. At each period of their building, mountains have arisen along lines of weakness in the crust, especially coast lines and the steep slopes marking the limits between continents and ocean basins. This is consistent with Joly's theory that the thrust of ocean beds against land margins is the cause.

The advocates of continental drift point to the siting of ranges across the paths along which the drifting movement is supposed to have occurred, and they consider that the moving masses are responsible; and indeed that the ridging and packing of the crust has in the end checked and stopped the movement. They note that the great western ranges of America occur in the path of any western drift of that continent, the Himalayas in the course of the postulated movement of India, the East Indies in front of Australia; and that the Alpine ranges of Europe may be linked with the crushing of Africa towards the north.

The 'nappes' of rock, cut off from their origin and sliding for dozens of miles, are a constant source of wonder to all who have considered the mechanics of mountain formation. They are so thin as compared with their great length and breadth, that it seems impossible to imagine them moved by any force other than one which would make itself felt throughout their every particle. Such a force is gravitation, and it is of interest that some Alpine geologists and Dr. Harold Jeffreys have used it in explanation of them. Prof. R. A. Daly has also adopted gravitation on an even greater scale in his theory of continental sliding: and one cannot fail to notice the increasing use of the term 'crust-creep' by those working on earth-movement.

Is there no other force, comparable in its method of action to gravitation, but capable of producing movement of the earth-crust in a direction other than downhill? Is it not possible, for example, that the tidal influence of the moon and sun, which is producing so much distortion of the solid earth that the ocean tides are less than they would be otherwise, and, dragging always in one direction, is slowing down the earth's rotation, may exert permanent distorting influence on the solid earth itself? May it not be that such a stress, if not sufficiently powerful to produce the greater displacements of continental drift and mountain building, may yet take advantage of structures of weakness produced by other causes, and itself contribute to the formation of nappes and to other movements of a nature at present unexplained?

Geological Surveying

Our knowledge of geology has been gained by the survey of the rocks, the study of their structures, and the delineation of both upon maps and sections. This work is being accomplished by geologists all over the world, and Great Britain and the Empire have contributed their full share. It is therefore opportune to note that there has just been celebrated the centenary of the Geological Survey of Britain and, with it, the opening of the new Geological Museum at South Kensington.

A century ago H. T. de la Beche, one of the devoted band of pioneer workers then studying the geology of the country, offered to "affix geological colours to the new maps of Devon and Cornwall" then in course of issue by the Ordnance Survey. His offer was accepted, and, at his own expense and on his own feet, he carried out a geological survey of some 4,000 square miles. In 1835 he was appointed to continue this task, with a small salary and a few assistants. Thus was started the first official geological survey, an example widely followed by other nations and dominions. De la Beche's conception included also a Museum of economic and practical geology, a Library, a Record of Mines, for which he secured support from a strong committee of the British Association in 1838, and a School of Mines for the scientific and technical education of those to be employed in the survey or exploitation of mineral resources. In these objects, and especially the last, he was warmly supported by the Prince Consort. He lived to see his visions all come true, as he collected round himself that wonderful band of surveyors, investigators, writers and teachers, which included such men as Playfair, Logan, Ramsay, Aveline, Jukes, Forbes, Percy, Hooker, and Huxley.

Some of the schemes planned by de la Beche have budded off and grown into large and important entities, rendering conspicuous service to scientific record, education, and research. But the main duties of the Geological Survey remained with it, and have been carried on for a century. These are to map the geology of the country on the largest practicable scale, to describe and interpret the structure of the land, to preserve the evidence on which conclusions have been founded, and to illustrate for students and other workers the geology of the country and its applications to economics and industry. The broad detail of the structure of the whole country is now known, but much new work must be done to keep abreast of or to lead geological thought. For example, the study of the cloak of 'superficial deposits', which often cover and conceal the structure of the more solid rocks below, is essential for the proper understanding of soils and agriculture; and a knowledge of the deep-seated geology of the country, which is often widely different from that nearer the surface and thus very difficult to interpret, is vital to the community for the successful location and working of coal and iron, and for tracing supplies of water and oil and other resources at depth.

Evolution of Life

Evolution of life on the earth has been by no means uniform; there have been periods of waxing and waning which may be attributed to geographical, climatological, and biological influences. The development of large land areas, ranged longitudinally or latitudinally, the invasion of epicontinental seas, the isolation of mediterraneans or inland seas, the splitting of continental areas into archipelagos or the reunion of islands into continuous land, the making of barriers by the rearing of mountain chains or the formation of straits or arms of the sea, the oncoming of desert or glacial climates; all such factors and many others have been of importance in quickening or checking competition, and in accelerating or retarding the evolution of life.

Probably, however, even greater effects have followed the interaction of groups of biological changes on one another. As an example I might recall Starkie Gardner's estimate of the results following upon the first appearance of grasses in the world. This seems to have been not earlier than Eocene, and probably late Eocene times. By the Oligocene they had made good their hold, peculiarities in their growth and structure enabling them to compete with the other vegetation that then existed; and gradually they spread over huge areas of the earth's surface, formerly occupied by marsh, scrub and forest. They have, as Ruskin says, "a very little strength . . . and a few delicate long lines meeting at a point . . . made, as it seems, only to be trodden on to-day, and to-morrow to be cast into the oven"; but, through their easy growth, their disregard of trampling and grazing, and by reason of the nourishment concentrated in their seeds, they provided an ideal and plentiful source of food.

On the establishment of the grasses, we find that groups of animals, which had previously browsed on shrubs and trees, adopted them, with consequent alterations and adaptations in their teeth and other bodily structures. To follow their food from over-grazed or sun-scorched regions they required to be able to migrate easily and quickly, and it was essential for them to discard sedentary defence and to flee from threatened danger. Such defence as was possible with heels, teeth or horns they retained; but the dominant modifications in

their organisation were in the direction of speed as their vital need.

Side by side with this development, and in answer to increasing numbers, came bigger, stronger and speedier carnivores, to feed on prey now so much more abundant, but more difficult to catch. The answer of the grass-feeders, with their specialised hoofs, teeth and bones, better suited to flight than fight, was to seek safety in numbers, and thus develop the herd instinct, with its necessity for leadership and discipline; but this, in turn, provoked a like rejoinder from some types of their enemies.

When it is remembered how much of the meat and drink and life of mankind is bound up with the grasses, including wheat, maize, millet and other grains, sugar-cane, rice and bamboo, we must realise how close is his link with the development just outlined. Practically his whole food supply is provided by them, either directly by the agriculturist who grows little else but grasses, or indirectly by the herdsman whose domestic animals are fed chiefly on the same food. Nor must we forget that almost every one of our domesticated animals has been derived from the gregarious types just mentioned, which have accepted the leadership of man in place of that of their own species.

It is perhaps not too much to say that the magnificent outburst of energy put out by the earth in the erection of the Alps, Andes and Himalayas in Tertiary times, was trivial in its influence for man's advent and his successful occupation of the earth in comparison with the gentle but insidious growth of "mere unconquerable grass" and its green carpet of "wise turf", which in some form clothes by far the greater part of the land of the globe.

Development of Brain

The kind of developmental reaction of which this is but a single example must clearly have had influence on bodily features other than bones and horns, teeth and claws, speed and strength; and one of the most striking has been on intellectual development and the size and shape of brain.

We do not, and perhaps can never, know the quality of the material of which the brains of fossil creatures was made, for we have no instrument to pierce the veil of time as the spectroscope has penetrated the abysm of space. But we are even now learning something about their shapes and convolutions, and more about their mass in its relation to the size of the bodies controlled; from the time of the earliest Ordovician fishes, through the history of the amphibia, reptiles, birds and mammals, up to man himself.

The brain of those gigantic if somewhat grotesque reptiles the dinosaurs, the tyrants of Mesozoic time, was relatively tiny. In *Diplodocus*, 80 feet in length and 20 tons in weight, the brain was about the size of a large hen's egg. It is true that there was a big supplementary sacral ganglion which may have taken chief charge of locomotion and helped to secure co-ordination throughout the hinder part of its huge length and bulk; but of true brain there was not more than a quarter of an ounce to control each ton of body and limb; and we begin to understand why they lost the lordship of creation.

The proportion of brain to body improved in those reptiles which took to flying, possibly in relation to their acquisition of warm blood, and in the birds evolved from reptiles; but it is only in mammals that a marked advance is seen. Here the brain of *Uintatherium*, a great rhinoceros-like animal of Eocene date, weighing 2 tons, was about the size of that of a dog. This proportion of half a pound of brain to each ton of body shows how far the mammals had gone, and still had to go. A twelve-stone man of the present day has about 3½ pounds of brain—an amount not far short of half a hundredweight per ton.

Even though we can know nothing of its material, this steadfast growth in the guiding principle, through the millions of centuries that have gone to its development, is surely one of the most remarkable conclusions that we owe to geology. Of all the wonders of the universe of which we have present knowledge, from the electron to the atom, from the virus and bacillus to the oak and the elephant, from the tiniest meteor to the most magnificent nebula, surely there is nothing to surpass the brain of man. An instrument capable of controlling every thought and action of the human body, the most intricate and efficient piece of mechanism ever devised; of piercing the secrets and defining the laws of Nature; of recording and recalling every adventure of the individual from his cradle to his grave; of inspiring or of ruling great masses of mankind; of producing all the gems of speech and song, of poetry and art, that adorn the world, all the thoughts of philosophy and all the triumphs of imagination and insight: it is indeed the greatest marvel of all.

When we contemplate the time and energy, the sacrifice and devotion, that this evolution has cost, we must feel that we are still far from the end of this mighty purpose: that we can confidently look forward to the further advance which alone could justify the design and skill lavished on this great task throughout the golden ages that have gone.

Summaries of Addresses of Presidents of Sections*

The Story of Isotopes

IN his presidential address to Section A (Mathematical and Physical Sciences), Dr. F. W. Aston says that the isotope chapter in the history of science contains much to interest the philosopher and offers many illustrations of that interplay of theory and experiment by which advance takes place. The postulate of Dalton that atoms of the same element are equal in weight was practically undisputed for more than a hundred years. It was correctly preferred to the alternative hypothesis of Prout. Early objections to the postulate were founded upon inaccurate data, and it was only disproved after the discovery of radioactivity.

Soddy's hypothesis of 'isotopes' was at first strongly resisted. Satisfactory proof of it from radioactive evidence could only be obtained in the case of lead, and this was established by chemical results during the War. The possibility that it could be applied to elements in general was first suggested by the twin parabolas of neon, and was proved by the results of the mass-spectrograph. The first of these instruments showed that neon and chlorine each consisted of two isotopes, that krypton had six, and other elements even more. By its means the 'whole number rule' of atomic mass was established and some fifty elements analysed. The difficulties of obtaining the rays for analysis varies enormously from element to element, but during the past fifteen years, knowledge of the isotopic constitution of the elements has become very complete. A year ago, data on all but four had been obtained, and since then the rays of three of these, produced by a new method, have been analysed by Dempster. Iridium is the only one now left. In all, some 259 stable isotopes are known. Elements of odd atomic number do not in general have more than two components but even elements are not so limited, the most complex, tin, having eleven.

One of the most astonishing results is that for practically every natural number up to 210 a stable atom is known. The determination of the relative abundance of isotopes in an element enables its atomic weight to be calculated. This has been done for nearly all the elements, giving valuable checks on the results obtained by chemical means.

The most important work now going on in this field is the measurement of the 'isotopic weights' of atoms. In recent years the accuracy has approached 1 in 10,000, but for theoretical considerations of nuclear structure and artificial transmutation even greater accuracy is desired. The first value obtained for the isotopic weight of hydrogen and the subsequent discovery of the heavy isotopes of oxygen suggested that hydrogen had a heavy isotope. This was discovered by Urey and called deuterium. It cannot be treated as a normal isotope, for its exceptional difference in mass enables it to be separated in a pure state. It has recently been used in the mass-spectrograph to give a more direct and reliable measurement of the isotopic weight of ordinary hydrogen, with the paradoxical result of removing the very discrepancy which led to its discovery.

Molecular Structure of Carbohydrates

PROF. W. N. HAWORTH'S presidential address to Section B (Chemistry) deals with the molecular structure of carbohydrates. Ten years have elapsed since the structural model of glucose was first presented as the six-atom ring form, an observation communicated to NATURE in 1925. This model now can be regarded as the unit of the carbohydrates cellulose, starch and glycogen. At the outset it was essential to investigate the mode of union of pairs of glucose units which occur in cellobiose and maltose, the bioses to which cellulose and starch give rise by graded breakdown processes. This occurs through the groups at the first carbon atom in one residue and the fourth carbon atom in a second residue, which furnish the oxygen bond uniting two glucose units in these bioses. The spatial disposition of this bond provides the reason for the different identities of starch and cellulose. In other carbohydrates the linking follows a different choice.

Investigations have demonstrated how cellobiose units are united in a continuous chain in cellulose, and how maltose units are assembled in starch. The chain lengths of these and other representative carbohydrates have been determined by the chemical assay of one of the terminal groups in the fully methylated polysaccharides.

A distinction is drawn between the chemical molecule, representing the assembly of glucose units by principal valencies, and the physical aggregate, which has much larger dimensions. Starch has a molecular weight of about 4000–5000, but this

* The collected presidential addresses at Norwich are being published under the title, "The Advancement of Science, 1935" (Norwich: B.A Reception Room London: Burlington House) 3s. 6d

chemical unit is capable of undergoing very considerable molecular aggregation, and these physical aggregates are undoubtedly very complex. Probably the same kind of interpretation should be applied also to cellulose. The aggregation of the chemical unit consisting of about two hundred glucose units may proceed to very great lengths of chain by co-ordination, and there is no doubt that the physical unit of cellulose is dimensionally very large. In this connexion lichenin has been simultaneously studied and its chain length determined. Its relationship to cellulose is similar to that between glycogen and starch.

Glycogen has a chemical molecule represented by a chain of twelve to eighteen α-glucopyranose units. This is smaller than that of vegetable starch, and the tendency to undergo molecular aggregation is not nearly so marked. Investigation of many degraded forms of starch representing different chain lengths has proved of service in the study of this problem.

New carbohydrates prepared artificially by the aid of moulds acting on glucose have resulted in the discovery of new modes of linking of hexose units. The chain length of several of these representatives is short and corresponds to about ten hexose residues. A new polysaccharide from grass, a levan, is found to be composed of ten fructose members united through positions 2 and 6, whereas inulin consists of about thirty fructofuranose units united through the positions 1 and 2.

Considerable interest is attached to investigations on the constitution of gums. A derivative of gum arabic is shown to possess properties resembling the specific polysaccharide of type III pneumococcus serum. Nothing could be more important than the development of the more recent discoveries of polysaccharides possessing immunological functions. A knowledge of their composition, properties and intimate structure will be of immense service to medicine.

Geological Research on Coal

SPEAKING of the state of knowledge at the commencement of this century regarding the real nature of coal, Prof. H. G. A. Hickling in his presidential address to Section C (Geology) says that it was a remarkable example of the tendency of research to pass over 'common' things, and also a striking illustration of the limitations of mere description to convey effective impressions of unfamiliar objects. A review of the writings of various earlier investigators of the last century in the light of present-day knowledge shows that, in their attempts to examine the structure of coal under the microscope, they had seen many of the features which have been revealed by the work of the past thirty years; but, on account of lack of effective illustration, and as a result of their inability to give correct interpretations of much of what they saw, their observations bore little fruit. Coal was still regarded as essentially one substance, and there was no sound basis for a classification of the different varieties, the existence of which the coal-user had perforce to recognise.

Recent work has brought vividly to light the fact that every piece of coal is a complex agglomeration of many different types of plant material; of the residues of wood and cellulose and proteins; of resins, waxes, gums and other substances. The development of microscopic technique has made it possible to show that almost the whole of the coal consists of larger or smaller plant fragments the original component materials of which still exist as discrete masses retaining their original forms, however much or little their ultimate compositions may have been severally modified. The microscope reveals, further, that while every coal is an aggregate, the ingredients differ widely in character and in proportions in different seams, and in different portions of the same seam. Modern research makes it increasingly clear that the problem of the classification of coals is twofold; to divide up the coals according to the nature of the original aggregates of plant debris from which each was formed; and, secondly, to determine the nature and extent of the chemical alteration which the aggregate has suffered after its entombment in the earth. The former determines the *type* of coal; the latter, its *rank*. Its economic qualities depend on both.

Hitherto, chemical examination of coal has been almost entirely confined to analysis of the whole mass, so that variations of composition due to type and rank respectively have not been distinguished; and the order which emerges from comparison of the analyses results only from the fact that, in the more common coals, the general constitution of the aggregate of plant debris is comparatively constant. The outstanding differences are consequently those due to rank. Extended study of the distribution of rank in its relation to the relative depth of different seams, and of the changes of rank exhibited by the various seams as they are traced through the coalfields, is making it increasingly clear that these changes are the result of varying temperatures and pressures to which the coals have been subjected in the earth's crust. Coal is far more sensitive to such changes than any other rock, and may well come in future to serve as the most delicate earth thermometer. Not only for such applications to purely scientific ends, however,

but also equally to provide the knowledge on which we must base any sound practice for the most effective utilisation of coal, it is essential to undertake a far more fundamental study of this mineral, and in particular to investigate separately the many components of the coal aggregate.

The Species Problem

MAINLY from a study of the water-beetles, Prof. F. Balfour-Browne has come to some conclusions as to the origin of species by means of natural selection which he brings forward in his presidential address to Section D (Zoology). He points out that, although a struggle for existence undoubtedly occurs, choice also plays a part in the formation of different communities of water-beetles associated with different types of habitat, and that even localisation under particular climatic conditions is probably partly due to choice.

Choice of a particular food-plant by certain individuals of a species may give rise to biological races, such as are known to exist in Nature and can be produced artificially, and such races may be one source of origin of new species. In any group, species are variously related, some being very distinct while others form clusters and are difficult to distinguish. The clustered species are not usually members of the same community and may perhaps be accounted for on the assumption that they originated as biological races. As to these clusters, there seems to be no evidence that the distinctive characters are hereditary, and it seems possible that they are merely due to the effect of environment upon each succeeding generation.

The majority of the species-characters by which the water-beetles are separated are non-vital and cannot therefore have evolved through the action of natural selection. In some cases the structure is common to other groups but the function is different. The clubbed antennæ found in Hydrophilidæ have appeared several times in the Coleoptera, but if they had been wiped out in all these other groups before the Hydrophilidæ were first studied, we should doubtless be describing them as specially evolved in connexion with respiration in these beetles.

Among these species-characters it is possible to trace what might be called stages in their evolution running through whole groups or families, suggesting that, just as growth is a definite property of the organism, so evolution is an inherent property of the species. But the discoveries in connexion with chromosome control of characters suggest that possibly what has been described as orthogenesis may be the result of mutations caused by external stimuli or, if function can produce an alteration of structure, physiological activities may produce these lines of evolution on the assumption, still requiring proof, that acquired characters are inherited. The inheritance of acquired characters must also depend upon the ultimate effect of changes of habit, physiological activity and structure upon the germ-cell chromosomes, so that the real struggle for existence seems to be in these latter, the first function of which is to see that like produces like, while external influences are perpetually endeavouring to prevent them carrying out their duty.

Polar Research

IN his presidential address to Section E (Geography) Prof. F. Debenham discusses "Some Aspects of the Polar Regions". In spite of an extensive literature on the exploration of the polar regions, there are few sources for a general appreciation of their value to man. The economic aspect is perhaps the best known, since most expeditions of the past have been prompted to some extent by hopes of making discoveries which would ultimately return a profit. Several of the earlier resources, however, were speedily exhausted by the spirit of competition which ruled amongst the different nations. The disappearance of the arctic whale and the reduction in numbers of the fur seal are two instances of this.

Among the potential values that yet remain to be exploited in the polar regions, there is the prospect of using them for air routes. Prof. Debenham urges caution as to acceptance of the exaggerated accounts of possible mineral wealth, especially in the Antarctic. Although by analogy with other parts of the world there are doubtless valuable deposits of precious metals, the almost universal covering of ice prevents prospecting and would hinder mining operations.

The economic aspects of the lands in high latitudes naturally lead to the subject of the national ownership of polar lands and the unusual conditions in which claims have to be made. In the Antarctic, in particular, there can be no occupation, and it seems that its place as a reason for territorial rights will have to be taken by exploration and investigation.

The polar regions are of interest as a field for adventure, and also, in the more accessible parts, as a resort for holidays. So far as Europe is concerned, however, the field is narrowed down to little more of the Arctic than the Svalbard (Spitsbergen) group of islands. Associated with this aspect is another which may yet prove to be of greater value than any other. The polar regions

are, so far as disease is concerned, the most healthy segments of the earth's surface. This is due to the simple fact that most of the disease-bearing organisms cannot live throughout the year in the low temperatures typical of those regions. It is reasonable to suppose that residence in those latitudes should be able to effect a cure for many of those diseases which depend on germs or are spread by infection. There have been some remarkable cases of complete cures from pulmonary affections in the case of members of expeditions. How far this would be true in the cases of actual patients remains to be proved. Medical faculties and foundations such as that of the Rockefeller Institute, whose business is the study of remedial medicine, are urged to endow and carry out research into these possibilities. There seems to be difficulty in securing endowment for such an investigation, which might be of permanent benefit to the sufferers of temperate lands, although there has been heavy expenditure of money on recent flights to the poles.

Examining the value to science of research in the polar regions, Prof. Debenham is of opinion that probably the science of meteorology has most to gain from a continuance of such co-operative work as was carried out in 1882 and 1932, and he commends the natural inclination of young men to visit the polar regions in search of either adventure or results of scientific interest.

Economic Nationalism and International Trade

THE presidential address to Section F (Economics and Statistics) by Prof. J. G. Smith discusses the problems created in the field of international trade by the great accentuation of economic nationalism which has taken place throughout the world owing to the trade depression in the past five or six years. He points out that this policy of economic self-sufficiency is not a new one and that there may be something to be said for a moderate dose of it, especially in countries the history of whose economic development is different from that of Great Britain.

There are two sets of broad influences to be considered which make for economic nationalism or autarchy: those due to the War and to the economic upheaval resulting from the War, and those due to what may be called long-term changes consequent on progress and on scientific invention applied to industry and to commerce. Among the latter are improvements in agricultural technique, which have removed the fears of food scarcity in industrial areas that were once a dominant factor making for freedom of trade, and the development of intricate machine tools, growth of technical education and wide distribution of electrical power, which enable new industries to be set up with equal prospects of success almost anywhere. Again, the vulnerability of modern large-scale rationalised industries causes a struggle for markets (in which Governments are necessarily involved) and high protection for the home market, which is the only one capable of effective control. Further, nationalism which originally had merely political aims has now changed its character and become largely an economic movement. Government control of the whole of economic activity exists already in the three totalitarian States of Europe; and Government regulation is growing rapidly even in such liberal States as France and Great Britain; while recent experience in the United States of America is very significant.

The short-term influences due to the War and to the depression have reinforced powerfully these longer-term movements. Undue concern about the balance of trade, the exact significance of which is frequently misconceived, has led to curious consequences. Quotas, control of foreign exchange, prohibitions of imports, originally designed with one object, have been developed for other purposes. The general result has been a diminution in the volume of international trade which is felt especially severely by a country in the position of Great Britain. It is probable that the desire on the part of Governments to exercise quantitative detailed control over foreign trade may disappear when the depression passes and that these short-term influences making for economic nationalism will lose their force; but it is unlikely that freedom of international exchange will soon return.

Prof. Smith considers the general policy most likely to help in the eradication of these more extreme influences and comes to the conclusion that, as they are due very largely to the instability of currencies and the unforeseen and violent movements of prices which always accompany unstable standards of value, the remedy is to be found in currency stabilisation. This, he considers, can only be attained by a return to a gold standard of some form or other. On the whole, he favours an early decision to link again with gold; for the refusal to act soon will tend to accentuate the difficulties which will be encountered when postponement can no longer be avoided.

Stability in Engineering

IN his presidential address to Section G (Engineering), Mr. J. S. Wilson, a practising civil engineer, has chosen to discuss a branch of engineering to which he has devoted much of his

time. The word stability as applied to a structure means, in a general sense, strength and endurance to resist the loads and forces to which the structure may be subjected. The loads and thrusts combined with the dead weight of the structure induce stresses and strains in the material of which it is built. The determination of these stresses and strains in the various members is a matter of calculation or applied mechanics. The maximum stresses allowed in the members must be chosen to suit the characteristics of the material used.

Thus there are two sides to all problems in stability. Great advances in both have been made during the last hundred years by the more extended use of mathematics or applied mechanics on one side and in the testing and improvement of materials and methods of construction on the other.

Three interesting episodes in the history of the subject are recalled. The first of these relates to the arch. Our knowledge of the stability of this form of structure was in a state of confusion up to the middle of the nineteenth century, when efforts to advance appear to have been more a matter of dialectics than of science or experiment. The sharp differences of opinion on principles of design on the part of those who wrote with authority on the subject led engineers and architects who actually built arches to take extraordinary precautions to ensure their stability. Reference is made to Dr. Johnson's views on the relative strengths of semicircular and elliptical arches.

The feeling of uncertainty regarding the stability of masonry dams which arose at the beginning of the century and the re-establishment of confidence in the methods of calculation previously accepted form the second episode. Experimental investigations with the aid of india-rubber models on the distribution of stress in dams, which were carried out by the late Mr. William Gore and Mr. Wilson, helped to clear up the uncertainty.

The third relates to suspension bridges and the introduction, in 1836, of Dredge's patent taper chain principle of design. Designs on the new principle were very economical in the amount of iron needed and those who advocated the adoption of the principle were powerful. The principle was fundamentally unsound and although it was criticised, engineers and applied mathematicians of the day were too uncertain, or commanded too little support, to be able to shake confidence in it, and a large number of bridges were built in Great Britain and in India. The first ones had some margin of stability by good luck rather than design, but the later ones failed either before completion or soon after.

These three episodes reflect on the advances made in our knowledge on the applied mechanics side of the problem of stability. With regard to the permissible or working stress side, on which the more economical use of material depends, progress has not been so rapid.

The Birthplace of Man

SIR ARTHUR SMITH WOODWARD'S presidential address to Section H (Anthropology) is an account of recent progress in the study of early man. Palæontology and geology contribute much to our understanding of prehistoric archæology. It has long been recognised that the earliest men of which traces have been found in Europe did not originate on this continent but were immigrants from some other region. It is therefore important to examine the numerous associated mammals to ascertain whence they came; for most of these mammals seem also to have been immigrants to Europe just before or during the Pleistocene period when man began to live here, and they may give a clue to his origins. These mammals show that when they flourished in Europe, the only direct land communication with the rest of the world was through Asia. The supposed connexions with Africa by way of Sicily and Malta and by Gibraltar have now been disproved. New discoveries of fossil mammals in the caves of Palestine and Syria show that during the early half of the Pleistocene period, Asia and North Africa were much more closely connected than they have been since. The explanation of the partial identity between the Pleistocene mammals of Africa and Europe is probably, therefore, that they had a common source in Asia.

Although the succession of stone implements in Pleistocene deposits in Africa is nearly the same as that in Europe, there is no evidence so far that the oldest types were made by the same primitive men. It is, however, now very doubtful whether the earliest tools in Kenya Colony were made by a modern race of men, as claimed by Dr. L. S. B. Leakey. The only fossil remains of man hitherto found in Africa seem to be related either to the surviving South African bushman or to the Australians.

The only known fossil which suggests that Africa may have produced man is the immature skull of an ape from Taungs in Bechuanaland, which was named *Australopithecus* by Prof. Raymond Dart. Numerous teeth and jaws of apes related to the chimpanzee are now being found in the Miocene of south-east Africa; but

teeth and jaws of apes, with perhaps still more human characters, are abundant in the Mio-Pliocene deposits of northern India. Indeed, the theory that man arose in central Asia from ground apes, which had been driven from the forests by the upheaval of the Himalayas, is still the best which has been proposed.

Man had reached the stage of *Homo sapiens* before he crossed the narrow seas from Asia to Australia. The fossils *H. wadjakensis* and *H. soloensis* from Java, and some fossil skulls from South Africa seem to represent his forerunners on the mainland.

H. sapiens, who had already learned the art of trimming stone by pressure flaking, seems to have been the first human immigrant to America by way of Bering Straits. Late palæolithic stone implements like those found in the Gobi desert were discovered last year in Alaska. Implements much like those of the Solutrean stage in Europe have now been found in several localities in the southern United States in association with extinct mammals of Pleistocene age. Human remains were first found directly associated with extinct mammals in South American caves by the Danish naturalist, P. W. Lund, whose centenary has just been celebrated by the scientific men of Brazil in Minas Geraes.

The Pituitary Gland

THE anatomical and physiological connexion between the pituitary and diencephalon form the subject of Prof. P. T. Herring's presidential address to Section I (Physiology). The diencephalon itself is the site of integration of nervous impulses concerned in the regulation of many of the fundamental processes of life. The pituitary body is the only one of the diverse structures of the diencephalon which receives an accession of epithelium from an outside source—the buccal epithelium. These epithelial elements of the pituitary form one of the most important structures of the diencephalon.

The pituitary body provides the brain with an armamentarium of hormones, which are secreted in several ways. Quite a large number of hormones are now allocated to the pituitary, and more may be discovered. Some of these exert their actions directly upon peripheral tissues through the blood stream; others act locally upon nervous mechanisms in the hypothalamus. All are under the control of this part of the brain.

From the anterior lobe are secreted hormones which stimulate growth and exercise a controlling influence over the gonads, thyroid, parathyroids, thymus, cortex of the suprarenals and the mammary glands. Some also influence metabolism, especially of carbohydrate and fat.

Pituitrin, an extract of the posterior lobe, has so far been separated into two fractions. One has a pressor effect. There are, however, anomalies in its action. It is also considered that the secretion of the posterior lobe is essential for the preservation of capillary tone. The other portion of pituitrin acts upon uterine muscle. The relationship of the secretion of the posterior lobe to the metabolism of carbohydrate and of fat is still obscure. Many other activities of the posterior lobe have been described and postulated, but one may well question if all be normal functions.

Nevertheless, one is compelled to conclude that the active principles of the pituitary are such as are necessary for the regulation of common and fundamental processes in the life of the animal. The diencephalon and pituitary body form a working unit, and have far-reaching importance in the control of fundamental physiological processes. It is probable that the pineal body is another part of the same mechanism, but its functions are still to be discovered.

Personality and Age

IN his presidential address to Section J (Psychology) on this subject, Dr. Ll. Wynn Jones directs attention to recent investigations with adult subjects. Most of the psychological measurements of the present century have been concerned with the mental traits of the child or the adolescent. Until recently, the later decades of human life had not been systematically studied. Adult populations are relatively inaccessible, the selection of samples presents statistical difficulties, and it is not easy to differentiate between what is largely native and what is largely acquired. Nevertheless, by the use of questionnaires, introspections, biographies, as well as various psychological tests, there has recently accumulated a mass of objective data concerning adults, resulting from the work of such investigators as Profs. Charlotte Bühler, Giese, Catherine and Walter R. Miles, Edward K. Strong, Terman, and Thorndike.

In brief, the effect of age, as such, on the ability to learn and, indeed, on most psychological abilities, is much less than has been generally supposed, not only up to middle age but even up to old age. It is true that elderly individuals, who still consider their powers to be at their zenith, may be objects of pity, but still more so, it would seem, are those who consider their abilities to have deteriorated long before that is actually the

case. Thorndike concluded that, in general, nobody under forty-five years of age should restrain himself from trying to learn anything because of a belief that he is too old to be able to learn it. For example, the facts are in flat contradiction to the doctrine that childhood is the period when it is easiest to learn to read, write or understand the hearing of a language. Similarly, objective tests of various sensory and motor and also of the more intellectual abilities show that the differences between old and young are small in comparison with the differences within either group.

Such findings have obvious applications to schemes of adult education or to the training of the unemployed. Ancient customs and opinions which had little scientific backing have in the past made it difficult for many of the unemployed to embark on any training for a new career. In industry it is especially important to obtain objective information regarding the handicaps of older workers. Age alone as a criterion for displacement or retirement is in many cases quite inadequate.

The question of age also arises in athletics. The ability of a sprint runner, which demands maximum expenditure of energy per second, is probably at its best at about twenty-three or twenty-four years of age. The half-miler must also learn economy of effort and its proper distribution, and his ability is at its maximum a year or two later. Much later are the maxima in sports requiring not only economy of effort but also the technique which only comes after long experience. Thus the median age of batsmen who have exceeded 3,000 runs in a season is 34·5 years; and the forty golfers who headed the Open Championship list in 1934 show a median of thirty-five years.

There are certain theoretical implications of these observations. Now that factorial analysis is proving so potent a method in psychology, it becomes necessary to study age in relation to personality more systematically. This will determine the relative importance of the various unitary traits at different stages of life, and this, in turn, will lead to a fuller psychological interpretation of the traits themselves.

Plant Pathology

MR. F. T. BROOKS'S presidential address to Section K (Botany) discusses certain aspects of recent investigations on disease in plants. With the discovery of the Mendelian inheritance of disease resistance, a potent weapon was placed in the hands of geneticists and pathologists for the control of plant diseases. Although sometimes very successful, the breeding of disease-resistant varieties cannot be looked upon as a panacea for the elimination of disease: great difficulties are sometimes experienced in building up these types, especially on account of the several diseases to which most crop plants are liable and the close linkage which often exists between a valuable quality and susceptibility to a particular disease; furthermore, progress along these lines with arborescent plants is necessarily slow. On the other hand, certain diseases can be effectively controlled either by paying due attention to environmental conditions which favour the host at the expense of the parasite, by the eradication of the sources of infection in accordance with the principles of plant sanitation, or by fungicidal treatment.

The influence of environment on the establishment of disease in plants is of outstanding importance. Environmental conditions which are most beneficial to the host frequently prevent attack by weak parasites. With fungi such as the rusts and downy mildews, however, optimum conditions for the host are often equally favourable to the parasite.

Much progress has recently been made in the study of the epidemiology of certain parasitic diseases, that is, the distribution in space and time of the causative micro-organisms which develop epidemically under favourable conditions. For example, in North America, Australia and India, an almost complete explanation is now available of the manner in which epidemics of black rust of cereals (*Puccinia graminis*) arise.

There are many physiologic or biologic forms within single species of parasitic fungi, especially in the rusts, a state of affairs which may greatly complicate the task of producing disease-resistant varieties. How these forms with different parasitic proclivities have arisen is an intriguing problem. It is known that sexual interactions between diverse forms may be the means of adding to their number, but it is suggested that gene mutation has also been a potent factor in their development. Although, in general, these physiologic forms are stable entities, their capacity for evolutionary change must not be forgotten.

Another active branch of plant pathology is that concerning the influence of one micro-organism on another in the establishment of disease. A host attacked by one fungus may thereby be rendered more susceptible to another, and a plant permeated by a complex of two viruses may exhibit symptoms unlike those induced by either virus acting separately. On the other hand, the effect of micro-organisms on one another may be one of antagonism. Of particular interest and of great importance is the antagonism shown by certain saprophytes to pathogenic fungi which invade the

underground parts of their hosts : indeed it is not too much to say that a new chapter in soil micro-biology has been opened with the recognition of this factor of biological antagonism. The pathogenicity of fungi which cause foot-rot of cereals may be completely suppressed by the antagonistic influence of soil saprophytes, either through the secretion of some toxic substance or perhaps by the stress of competition. When more is known about the antagonism of other micro-organisms to pathogenic fungi in the soil, it may be possible to devise methods of biological control, such, for example, as altering soil conditions so as to favour the antagonistic action of other members of the micro-flora.

The Schools and Citizenship

DR. A. W. PICKARD-CAMBRIDGE has chosen "Education and Freedom" as the title of his presidential address to Section L (Educational Science). In Germany, Italy and Russia the suppression of freedom is largely carried out by the control of education, of which the aim is to teach the individual not to think. If freedom is to be maintained, it can only be by an education designed to teach the young to think freely and accurately, and to act as responsible citizens of democracy. The ideal community will be one which allows all to take a share in the formation of public opinion (and trains them to do so), and in which no one is simply a means to the ends of others, but each is free to realise the highest values and able to make his contribution to the common good. In the individual life, freedom, which is at first possessed only in a small measure, cannot usually be acquired without discipline and the presentation of the higher values by authority, and one function of education is to give the young a chance of appreciating these higher values, both by suggestion and example, and also in school work, for example, in the study of literature and history and the much-neglected study of the Bible.

Another function is to produce the habit of clear and accurate thinking. For this a citizen needs in later life access to the facts about which he is to form judgments, and this (as the popular Press is at present) is hard to obtain. In his education he should have practice in forming judgments upon evidence, and in all his work there should be insistence on individual thinking, not on mere absorption of lessons or rules-of-thumb. In many of the secondary schools of Great Britain—which are the key to the situation, since from them will come most of the teachers of the mass of the people and the leaders of opinion in most of the smaller circles in which public opinion is made—more practice might be given to the pupils in the management of their own affairs out of school, and in activities which encourage self-expression.

Examinations as at present treated in schools, largely owing to the excessive stress laid upon them by education authorities and employers, are serious obstacles to the acquisition of freedom and independence of mind, and here serious reforms are necessary. Other reforms, such as the prolonging of the time of education and the reduction of the size of classes, are urgently required, if the young citizens' capacity for freedom and for the citizenship of a free State are to be developed. All educational institutions and methods must be tested at every point by their tendency to produce or to hinder such freedom, and everything eliminated that makes for the standardisation of individuality or is hostile to ultimate independence of judgment, while at the same time the higher values (which make for good life and good citizenship) are so presented to the young that they may have the chance of freely making them their own.

State Control in Agriculture

IN his presidential address to Section M (Agriculture), Dr. J. A. Venn discusses the "Financial and Economic Results of State Control in Agriculture". A rather full criticism is made of agricultural economics and organisation from the end of the Napoleonic wars, until the beginning of the Great War—including that "period of rural depression of the 'nineties . . ." which finally passed "without affecting either the National outlook or the National purse".

The War years were a period of rigid control, and are therefore not considered. The present period began in 1922. The cost to the State of reliefs and disbursements are estimated. For example, the subsidising of sugar and molasses derived from home-grown sugar beet has been, during eleven years, slightly more than £47,000,000. The Forestry Commission will, in fifteen years, have expended £6,000,000. Non-returnable State contribution to the Milk Marketing Board amounted in 1934–35 to £1,600,000, and within a year £2,924,000 have been expended on the beef subsidy. Reliefs from rating must represent some £15,000,000 annually.

Recent tendencies involve a slight increase in output of the soil, a decline in arable area, a transference from production of feeding-stuffs to

that of sale crops, a reduction in number of workers, and a redistribution between the different classes of livestock. Of the expenditure that these results have involved, landowners have directly received little, and continued to deteriorate. Tenant-farmers have partly bridged a gap to save them from impotence as producers; while rural workers have received an increase of 75 per cent in wages. Recent 'planned' agriculture gives a figure of £40,000,000 in annual benefits derived from grants, remissions and augmented prices. It is arguable to what extent the middlemen's returns have been affected; but it may concern intimately the consumer. The direct tax-payer has gained a measure of respite, at the expense of the indirect.

A vast change has occurred in the problems of agriculture during the past hundred years, and consideration has ousted severity, and preferential treatment superseded laissez-faire. Agriculturists are faced with the twin problems of over-production and under-consumption. The most recent proposals involve a movement from quotas to levies, with a modicum of Dominion preference. Nevertheless, British agriculture has gained a protective covering to shield it from the worst economic shocks. But this may actually hamper it when progressing over the smoother terrain of normality which it is hoped lies ahead. Possibly the near future will witness some relaxation from control and some restoration of individual liberty of action.

Preservation of Sites of Scientific Interest

PROF. P. G. H. BOSWELL'S presidential address to the Conference of Delegates of Corresponding Societies deals with the preservation of sites of scientific interest in relation to town and country planning. One of the most enlightened enactments placed upon the Statute Book for a long time is the Town and Country Planning Act of 1932, wherein it is laid down that a local authority or joint committee must obtain the approval of the Ministry of Health before it can implement any resolution relating to a scheme of planning. Among the objects of such a scheme, as cited in Section 1 of the Act, are "preserving existing buildings or other objects of architectural, historic and artistic interest, and places of natural interest or beauty, and generally of protecting existing amenities whether in urban or rural portions of the area".

Formerly, the success of efforts directed to the preservation of sites and objects of scientific interest was due to the enthusiasm of advocates, and the broadmindedness and public spirit of landowners and benefactors. While this good work will, it is hoped, still continue, much more power is now in the hands of the people. But, as ever, knowledge is a prerequisite of useful action. How can the British Association, and in particular the Corresponding Societies, inform the people and assist them to safeguard their natural heritage?

Judging from the frequency of references to this and to cognate subjects in the columns of the daily Press, there can be no doubt as to the public awareness of the desirability and necessity for preserving sites and objects of scientific interest and natural beauty. The Ministry of Health has given opportunity to the Association to advise as to when action ought to be taken—that is, to conserve, concentrate and direct energy which might otherwise be dissipated in isolated action or unprofitable controversy. The areas in which planning schemes are proposed are notified to the British Association, a body admittedly well-fitted to advise the Ministry, by its aims and constitution, by its liaison with the Corresponding Societies, and by the call it can make upon scientific experts within and without its ranks.

Obviously, before the Association can act effectively, the requisite information regarding the existence of objects and sites worthy of preservation must be available. So far as botany and zoology are concerned, no systematic attempt to compile a list appears to have been made, but in the case of geology an inquiry was instituted some years ago by the Geological Society among local geologists and learned societies, with the result that a valuable though incomplete list was drawn up. In order to make the list as complete as possible, the Association is in a position to call to its assistance (*a*) its Corresponding Societies and their delegates; (*b*) the specialist learned societies; (*c*) officials of local museums and libraries; and (*d*) teachers in universities, colleges, and in public, grammar, secondary and technical schools. The reference list which may thus be compiled will be available for consultation as each scheme of planning is notified; and where there is doubt as to the best policy to pursue, the advice of experts on the panel already drawn up for the purpose by the Council can be sought.

Details are given of sites of scientific interest which should be preserved (*a*) in the area of Darwin's home at Downe, now held in trust by the British Association, and (*b*) in East Anglia.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

other. It helps also in the search for methods to control abnormal growth: the action of radium on a tissue culture can show how it may be used most effectively in the treatment of cancer. The director's Report gives brief abstracts of the different researches at present in progress.

Imperial Agricultural Bureaux

THE fifth annual report (1933–34) of the Executive Council of the Imperial Agricultural Bureaux has now been published (London: H.M. Stationery Office, 4*s*. net). Consequent on the recommendations of the Imperial Committee on Economic Consultation and Co-operation (1933), the Council, in addition to its previous duties, has taken over the administration and financial control of the Imperial Institute of Entomology and of the Imperial Mycological Institute. Special prominence is given in this year's report to the work of these Institutes, and the degree of their activity may be judged by the fact that, on an average, more than 2,000 specimens a week have been received for identification by the former, and material has been forwarded from thirty-five Dominions and Colonies to the latter Institute during the year under review. The parasite laboratory at Farnham Royal, started by the Empire Marketing Board, has also passed under the control of the Council, and now draws common financial support. The work of the eight original bureaux continues to develop, and increased use is being made of the information services available by research institutes and research workers throughout the Empire.

Madras Fisheries

DR. B. SUNDARA RAJ, director of fisheries, Madras, in his administration report for the year 1933–34 (Madras Fisheries Department), 1934, shows that the outstanding event of the year, which has brought back some measure of prosperity to the fishing industry of the west coast, was the return of the oil sardine in unexpected abundance after an absence almost complete for an unusually long series of years. The oil sardine (*Sardinella longiceps*) is the most important economic fish of the west coast, and its absence had reduced the fishermen to extreme poverty. Its return was just in time to save the industry from extinction, though advantage could not be taken of the abundance of the fish owing to the prevailing economic depression. Samples were examined twice a week and studied in detail. Research in all directions is progressing, an important result being the success obtained in keeping live pearl oysters under artificial conditions at the Krusadai Biological Station. This points to the possibility of establishing an oyster park which is one of the principal aims of this station. Oysterlings of 30–40 mm. have lived in cages well over a year, during which several have grown to almost adult size (50–65 mm.). There is evidence of the larger oysters in the cages having spawned in captivity. Spawn has been found in the cages, and a pycnogonid found swarming in them had young microscopic oyster spat attached to the lateral processes. Special attention is being given to determination of age and rate of growth. Other investigations are in progress including a systematic survey of deep-sea fishing grounds by the trawler, plankton investigations, fish eggs and larvæ, daily collection of food fishes and hydrographical records, whilst technological research is not neglected. The whole report is exceedingly interesting and instructive, showing much activity in all directions.

Literature of Food Investigation

THE first number of vol. 6 of the "Index to the Literature of Food Investigation" reviews the developments during the years 1932–33 (Department of Scientific and Industrial Research: Index to the Literature of Food Investigation: Vol. 6, No. 1, March 1934. Compiled by Agnes Elisabeth Glennie, assisted by Owen Davies. London: H.M. Stationery Office, 1935. Pp. 309+v. 5*s*. net). One of the most important is the application of gas storage to meat: by increasing the amount of carbon dioxide in the atmosphere to 10–12 per cent, it is possible to keep chilled meat in good condition for about seven weeks, so that chilled, instead of frozen, meat can be brought to Great Britain from so far away as New Zealand. Among other problems relating to animal products to which attention is directed are the onset of rancidity in stored food and the production and use of fish oils, which has assumed increasing importance with the development of our knowledge of the value of vitamins A and D as dietary factors.

HALIBUT liver oil is a rich source of vitamin A, often 50–100 times as rich as cod liver oil: the liver oil of the ling cod may contain about eight times as much vitamin D as cod liver oil: the latter is not present in the liver oils of cartilaginous fish or in the liver fat of whales and other mammals. In the case of milk and milk products, reference is made to the pasteurisation of milk, the effect of processes of manufacture on the solubility of the protein of milk powders and the keeping qualities of butter. Interest continues to be shown in methods of freezing animal and vegetable tissues. Quick freezing has no advantage over slow freezing, so far as the palatability of meat is concerned, nor has it any advantage in the preservation of peaches, strawberries or apple cider. Freezing orange and grapefruit juices does not usually affect the vitamin C potency. The importance of research into the problems of the storage and transport of fruit is shown by the fact that in 1932 more than 100,000 tons of oranges and 7 million bunches of bananas were brought to Great Britain in refrigerated ships, and emphasis is laid on the fact that the most satisfactory method of ascertaining the best storage temperatures for ocean transport is to make precisely controlled storage trials in the country of origin of the fruit.

New 'House Number' Lamps

THE names of the streets round London are usually placed in a conspicuous position and are well lit by some neighbouring lamp, but in some of the side

streets and avenues it is difficult to identify the number of the house. The illumination of these numbers would often be a great boon. In the August number of *Helios*—the German export journal for the electric industry—it is stated that in many newly built suburbs 'number lamps' have been installed over the front doors or in other convenient spots. Several of the older streets also are being equipped with these lamps. Electricity supply companies are encouraging their use by giving the consumer energy for illuminating the lamps at a specially low rate. The number lamps illustrated in the journal are prismatic in shape, three of the edges being vertical and the top and base being horizontal. Expensive shades in opal glass are sometimes used, but owing to the risk of breakage, most people use a cheaper form. Simple panes of glass are put in a cast iron frame. They can be easily removed for cleaning and in the event of an accident the pane can be easily replaced. The transparent number panes are placed in a black frame and the triangular base of the lamp is provided with an opal glass pane which lights up the entrance to the house.

Physics Research at Harvard

Contributions from the Physical Laboratories of Harvard University, vol. 22, is a collection of separate copies of 29 papers which have been issued by the Laboratory during the years 1932–33, bound together and provided with a table of contents. It extends to about five hundred pages, but the pagination of the original memoirs is retained. More than half of the volume is occupied by papers written by Prof. P. W. Bridgman or by workers in his laboratory. They add considerably to our knowledge of the properties of substances under great pressures. A paper by Prof. Bridgman puts forward serious criticisms of some of the methods of proof used in the current theory of groups (*mengenlehre*). Several of the remaining papers issue from the laboratory of Prof. W. Duane, and deal with investigations of atomic and molecular properties, while others dealing with spectroscopic investigations originate in Prof. T. Lyman's laboratory. Two others deal with vapour pressures and entropy, one with the magnetic properties of certain iron alloys, and another with the large changes of ionisation of the atmosphere which are produced by solar eclipses. Readers of these contributions will be struck by the importance of the work which is being done by 'National Research Fellows'.

The Fish and the Ring

THE city of Glasgow bears in its coat of arms a fish with a ring in its mouth, and the incident so commemorated involved a lady's honour in the days of St. Kentigeon. But since rubber rings were invented, the association between fish and ring has become a matter of solid fact. In the *Australian Museum Magazine* of April, G. P. Whitley has collected accounts of curious cases where fishes have become involved in rings, and the examples range from garfish and mackerel with rubber rings surrounding and even partly embedded in their bodies, to a shark, captured at Havana, Cuba (recorded by Dr. Gudger), and adorned by a motor-car tyre which encircled its body and was prevented from slipping over the tail by the dorsal fin and from slipping over the head by the pectorals.

Land Speed Record

SIR MALCOLM CAMPBELL made a new world land-speed record on September 3 by driving his *Bluebird* car on the Bonneville salt flats in Utah at a mean average speed of 301·337 miles per hour. In the first run, he was stated to have covered the measured mile in 11·83 sec., which works out at 304·311 m.p.h. The second run was stated to have been covered in 12·18 sec., giving a speed of 295·566 m.p.h. His average speed was therefore given as 299·875 m.p.h. Later it was announced that there had been a miscalculation of the time, and the average speed was corrected to 301·337 m.p.h.

Announcements

THE autumn meeting of the Institute of Metals will be held at Newcastle-upon-Tyne on September 9–12. The proceedings will begin in the evening with the delivery by Dr. H. W. Brownsdon of the fourteenth annual Autumn Lecture on "Metal Melting: its Effect on Quality". Following the lecture, a general discussion will take place on several different phases of the lecturer's subject. No tickets are required for admission to the lecture, which will be given in the King's Hall, Armstrong College, at 7.15. Visitors are admitted to the business sessions, beginning each morning at 10 a.m., on signing the visitor's book in the New Mining Lecture Theatre, Armstrong College.

A VOLUME of collected researches published from the Wards and Laboratories of the London Hospital during 1934 has been issued (London: H. K. Lewis and Co., Ltd. 7*s*. 6*d*. net). The papers included extend over a wide range of subjects, and mostly embody original observations of importance for the diagnosis, prognosis and treatment of disease.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant (Grade II) and a junior assistant in radiological research, a junior assistant and two assistants (Grade II) in ballistics research, and an assistant (Grade I), an assistant (Grade II) and a junior assistant in explosives research, in the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18 (Sept. 14).

A junior scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Sept. 21).

An assistant curator of the Museums in Leeds—The Town Clerk, Room 57, Civic Hall, Leeds, 1 (Oct. 7).

A lecturer in mathematics in the University of Tasmania—The Agent-General for Tasmania, Australia House, Strand, London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 398.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Charles Darwin and the Galapagos Islands

IT seemed possible that an examination of some of the unpublished Darwin manuscripts dealing with material collected during the weeks spent on the Galapagos Islands might bring fresh light to bear on the much discussed manner of growth of his evolutionary outlook. At what period during the *Beagle* voyage did his views crystallise ?

We know that in 1837 Darwin opened his first notebook on the transmutation of species, and made especial tribute to the Galapagos species as the origin of all his views, together with the South American fossils. But little sign of such a revolution found its way on to paper at the time. I have therefore been fortunate in finding among the contemporary ornithological notes a passage bearing directly on the subject, where the significant phrase "for such facts would undermine the stability of species" occurs. Here we have the earliest date yet obtained, I think, for an admitted upheaval of his thoughts along evolutionary lines. The ferment had already begun to work in September 1835.

As the passage in the manuscript differs widely from what was printed, both in the "Voyage of the *Beagle*" (1870, pp. 394–5), and in the "Birds of the Voyage" (Part 3, "Zoology of the Voyage", 1841, 4to) it may be worth quoting it at greater length.

"*Thenca*. [Mimus Thenca.] These birds are closely allied in appearance to the Thenca of Chile. They are lively, inquisitive, active, *run fast*, frequent houses to pick the meat of the tortoise which is hung up,—sing tolerably well,—are said to build a simple open nest,—are *very* tame, a character in common with other birds. I *imagined*, however, its note or cry was rather different from the Thenca of Chile— ? Are very abundant over the whole Island ; are chiefly tempted up into the high and damp parts by the houses and cleared ground.

"I have specimens from four of the larger Islands ; the specimens from Chatham and Albemarle Isd. appear to be the same, but the other two are different. In each Isd. each kind is *exclusively* found ; habits of all are indistinguishable.

"When I recollect the fact, that from the form of the body, shape of scales and general size, the Spaniards can at once pronounce from which Isd. any tortoise may have been brought :—when I see these Islands in sight of each other and possessed of but a scanty stock of animals, tenanted by these birds but slightly differing in structure and filling the same place in Nature, I must suspect they are only varieties. The only fact of a similar kind of which I am aware is the constant asserted difference between the wolf-like Fox of East and West Falkland Isds.— If there is the slightest foundation for these remarks, the Zoology of Archipelagoes will be well worth examining ; for such facts would undermine the stability of species."

Yet this profound change of view is scarcely discernible in the different editions of "Voyage of the *Beagle*". Even in the second edition of 1845, the words "creation" and "creative force" are used in the Galapagos discussion in the traditional sense. Darwin took no pleasure in overthrowing preconceived doctrines ; he entered the new road cautiously, determined to pave it with solid accumulated evidence. Probably a certain deference to Capt. FitzRoy's views, emphatically creationist, helped to delay the unfolding of Darwin's divergent opinions.

In this respect, FitzRoy's description of the birds of the Archipelago is in interesting contrast to the quotation from Darwin. "All the birds that live on these lava-covered islands have short beaks, very thick at the base, like that of a bull-finch. This appears to be one of those admirable provisions of Infinite Wisdom by which each created thing is adapted to the place for which it was intended. In picking up insects or seeds which lie on hard iron-like lava, the superiority of such beaks over delicate ones, cannot, I think, be doubted. . . ."

It is sad to learn from Ecuadorian sources that the Galapagos Archipelago is no more ; it is now the Archipielago de Colón. Moreover, Chatham Island has become San Cristobal, Hood and Charles are Española and Santa Maria Floreana, whilst Albemarle is Isabella. Perhaps in all truth as fitting a collection of names for the Pacific Ocean as our old ones of British kings, admirals and statesmen ; but saddening to insular tradition.

NORA BARLOW.

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Wendover,
Bucks.

X-Ray Examination of the Effect of Removing Non-Cellulosic Constituents from Vegetable Fibres

THE cellulose of the cell-wall and fibres of most plants contains closely associated polysaccharide material which is generally a xylan. The cotton hair is unique in being free from xylan, but manilla hemp, jute and sisal, for example, may contain as much as 15–20 per cent. The view has been put forward tentatively that the xylan molecules in such fibres participate in the micelles and are oriented in the same direction as the cellulose chains[1] : the period along the fibre-axis of xylose residues in oriented xylan would be very much the same as that of the glucose residues in cellulose, and their presence should make no fundamental difference to the X-ray photograph. In support of this view there is the well-known fact that actually no such difference is observed in the ordinary way.

In carrying out a more serious test of the hypothesis, we have recently, among other things, examined by X-rays the effect of removing progressively the xylan (initially 19·8 per cent) of cellulose fibres from manilla hemp, using an apparatus specially designed for taking strictly comparable photographs on one and the same film[2]. By this means very accurate comparisons were possible, but again no really fundamental change was revealed. Briefly, it may be said that removing xylan from fibres of high xylan content merely makes their X-ray photographs more like those of fibres of low xylan content! The point of this apparently pointless verdict is that the X-ray photographs of fibres of low xylan content—ramie and Italian hemp, for example—show certain diffraction features typical of a more perfect state of crystallisation. The result of these experiments is therefore definitely in favour of the view that the incorporation of xylan is a sort of mixed crystallisation.

A number of common fibres were also purified by removal of lignin and encrusting hemicelluloses. As would be expected, the effect of this treatment was in general to clarify the X-ray photograph, and in most cases to lead to improved definition through a sharpening of the crystallite orientation. Otherwise, nothing of any great significance was observed. Much depends on the care with which the chemical pre-treatment is carried out, for it is possible to injure the crystallite orientation instead of improving it. Miles Thomas and Hewitt[3] report a diminished *intensity* in photographs of purified fibres; but we have not observed such an effect.

The photographs and experimental details of the work will be published in due course. In the meantime attempts are being made to obtain an X-ray pattern from xylan alone.

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[1] Norman, *Science Progress*, **27**, 299; 1933.
[2] Cf. Astbury and Woods, *Phil. Trans. Roy. Soc.*, A, **232**, 333; 1933.
[3] NATURE, **136**, 69, July 13, 1935.

Sub-Boundaries in a Crystal Grown by the Bridgman Method

INTEREST in irregularities observable in single crystals has arisen through the large discrepancies between the results of experimental studies of some of the physical properties of crystals and theoretical studies based on the idea of a single uniform lattice extending throughout each single crystal.

An observable irregularity has been found in working with a single crystal of copper grown by the Bridgman method. In trying to get an undistorted section parallel to the 311 planes for use as an X-ray polariser[1] many surfaces had to be cut, etched and examined under the microscope. The appearance of one such section, shown in the photomicrograph (Fig. 1), suggests that the crystal had broken down into a large number of small ones, the outlines of which are seen as the curved lines. The etching had been done with nitric acid, which develops the cube planes, so that the whole surface was covered by tiny cubes each having one corner projecting.

It was noticed that, as nearly as could be judged by eye, not only were the whole of the cubes similarly orientated, as would be expected in a single crystal, but also some of the individual cubes actually crossed the curved boundary lines. Both effects were easily seen distributed over the whole 7 mm. of crystal and they are detectable in the photomicrograph. The arrow is parallel to a cube face. The grinding marks are parallel to the two edges of the page. X-ray photographs showed that if the crystal had broken up into smaller ones, their orientation was unchanged within the limits of the experimental accuracy.

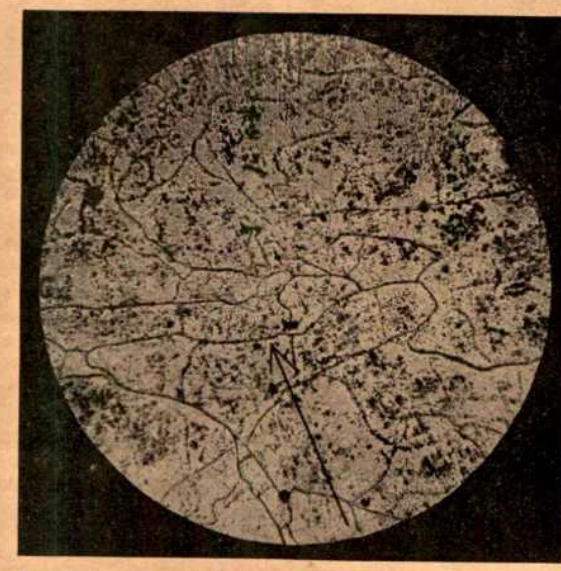

FIG. 1. Etched section of a single crystal copper rod cut parallel to (311) planes showing, to left of arrow, sub-boundaries crossed by cube edges. (× 30.)

Sir Harold Carpenter kindly pointed out that the markings are similar to the 'sub-boundary' or 'veined' structures observed in many metals. In the literature, these have been studied in the individual grains (crystals) of polycrystalline material but their nature is apparently not understood yet. Smithells and Rooksby[2] suggest that the sub-boundaries are formed under the influence of stresses set up during the rapid cooling of the metal (tungsten). Such a hypothesis would be untenable for copper as the observations here reported were made upon a crystal cooled very slowly. Furthermore, Northcott[3] was able to suppress veining in polycrystalline copper by quenching from 1,000° C. The etching which is favourable for revealing sub-boundaries is not always favourable for showing the crystal orientation. In preparing the specimen illustrated, the acid was applied to the clean dry surface held by the side of a running tap, so that the action could be stopped quickly after about one second.

Since these sub-boundaries can be found in single crystals, it is evident that their possible influence upon some physical properties can be studied in types of experiment not possible with polycrystalline material where they have been observed hitherto.

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[1] George, NATURE, **136**, 180, Aug. 3, 1935.
[2] Smithells and Rooksby, NATURE, **120**, 226; 1927.
[3] Northcott, *J. Iron and Steel Inst.*, **126**, 274; 1932.

Change of Magnetic Susceptibility of Metals during Melting and Allotropic Transformation

THE change of magnetic susceptibility during allotropic transformation or melting of metals was first observed by one of the present writers[1] about twenty-five years ago, in his measurement of the magnetic susceptibility of pure metals at temperatures ranging from room temperature up to 1,000°. In that paper the remarkable fact was mentioned that the magnetic susceptibility of tin changes its sign twice as the temperature rises. That is, the change of grey tin, which is a strongly diamagnetic substance, into white tin at 18°, is accompanied by an abrupt increase of susceptibility, which becomes thus paramagnetic, and afterwards this susceptibility remains constant up to 232°, at which temperature it resumes its diamagnetic properties on melting. In order to obtain a more accurate value of the susceptibility change during allotropic transformation or melting, we have recently measured the susceptibility in vacuum, and have succeeded in explaining the phenomenon in a quantitative way by applying our former theory[2] which has been proposed to explain the change of susceptibility in metals caused by cold working.

This note contains a preliminary report regarding metals such as tin, copper, silver and gold that show the above phenomenon.

In our theory, we assume that the magnetic susceptibility is affected by the volume change caused by an allotropic change or melting in two different ways: (1) the change of paramagnetic susceptibility due to the diminution of free electrons caused by the expansion; (2) the change of diamagnetic susceptibility due to the increase of bound electrons caused by the expansion. In the case of contraction, the free electrons increase at the cost of bound electrons, and hence the changes due to (1) and (2) are exactly opposite.

Now, according to W. Pauli, L. Landau and L. Posener[3], the first change of susceptibility is given by

$$d\chi_1 = +\frac{2}{9}\frac{CL^{\frac{1}{3}}\alpha_0^{\frac{1}{3}}}{W^{\frac{1}{3}}\rho_0^{\frac{1}{3}}}\left\{-2+\frac{A}{3\alpha_0}\left(\frac{4\pi}{3M}\rho_0\right)^{0\cdot488}\right\}\frac{d\rho}{\rho_0},$$

where $C = 2\cdot21 \times 10^{-14}$, L = Loschmidt's number per mol, W = atomic weight, ρ = density, α = number of free electrons per atom, $A = 2\cdot261 \times 10^{-12} Z^{0\cdot513}$, Z = the atomic number and M = mass of the atom.

According to Sommerfeld[4] and T. Hironé[5], the second change of susceptibility is given by

$$d\chi_2 = -\frac{4\cdot13 \times 10^{-7} Z^{-\frac{1}{3}}\alpha_0 x_0}{a\ W}\left(\frac{3M}{4\pi}\right)^{\frac{1}{3}}\cdot\rho^{-\frac{1}{3}}\cdot\frac{d\rho}{\rho_0}+$$

$$\left\{2\cdot06\times10^{-7}x_0^2Z^{-\frac{1}{3}}+0\cdot662\times10^{-5}\alpha_0^{-\frac{1}{3}}\right\}\frac{A}{W}\left(\frac{4\pi}{3M}\rho_0\right)^{0\cdot488}\frac{d\rho}{\rho_0};$$

$$\text{where } x = \frac{r}{a},\ a = \frac{0\cdot4676}{Z^{\frac{1}{3}}}\times10^{-8},\ r = \sqrt[3]{\frac{3M}{4\pi\rho}}.$$

Hence, $d\chi = d\chi_1 + d\chi_2$.

ρ, $d\rho$ and α^0 being known from the experimental data, all the quantities found in the expression for $d\chi$ will be known, and $d\chi$, therefore, can be calculated.

The result of the calculation by the above method and also the observed change of magnetic susceptibility for tin, copper, silver and gold are given in the accompanying table:

Phase change	α_0	ρ_0	$\frac{d\rho}{\rho_0}$	$d\chi_1 \times 10^6$	$d\chi_2 \times 10^6$	$d\chi \times 10^6$ (theor.)	$d\chi \times 10^6$ (obs.)
Allotropic change, white tin → grey tin	0·06	7·29	− 0·20	− 0·031	− 0 273	− 0·31	− 0·32
Melting of tin	0 043	7·18	− 0 028	− 0·006	− 0·047	− 0·052	− 0·061
,, ,, copper	0·036	8·38	− 0 041	− 0 011	− 0 153	− 0·164	− 0·120
,, ,, silver	0·044	9·86	− 0 050	− 0 009	− 0·105	− 0·114	− 0 097
,, ,, gold	0·043	18·39	− 0·052	− 0 007	− 0·080	− 0·087	− 0 071

Thus the very interesting phenomenon mentioned above in the case of tin can be explained by our theory. As is seen from the table, the observed change of susceptibility from white tin ($\chi = +0\cdot027 \times 10^{-6}$) to grey tin ($\chi = -0\cdot29 \times 10^{-6}$) is $-0\cdot32 \times 10^{-6}$, while the theoretical value is $-0\cdot31 \times 10^{-6}$; and the observed change in susceptibility of tin during melting from paramagnetic to diamagnetic is $-0\cdot061 \times 10^{-6}$, while the theoretical value is $-0\cdot052 \times 10^{-6}$. A similar comparison between the observed change of the susceptibility during melting and its calculated value in the case of copper, silver and gold shows also good agreement between these two values.

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July 8.

[1] K. Honda, *Ann. phys.*, 32, 1027; 1910.
[2] K. Honda and Y. Shimizu, NATURE, 132, 565; 1933. Y. Shimizu, *Sci. Rep.*, 22, 916; 1933.
[3] *Z. Phys.*, 41, 99; 1927. 64, 629; 1930. 75, 809, 1932.
[4] A. Sommerfeld, *Z. Phys.*, 78, 283; 1932.
[5] T. Hironé, to be published in near future.
[6] K. Honda, T. Nishina und T. Hironé, *Z. Phys.*, 76, 80; 1932.

Production of Electron Pairs

DIRAC's theory of electrons gives us the possibility of calculating the production of electronic pairs by collisions between electrons and nuclei. This process may be described as a second order effect of the perturbation of plane electron waves due to the nuclear field, and to the interaction between the incident electron and the electron which originates the pair in the transition from a negative to a positive energy state (rising electron).

If we regard the nuclear field as acting only on the rising electron, and if we assume Møller's[1] primitive electron interaction, we obtain as the cross-section for the production of a pair, of energy between ε and $\varepsilon + d\varepsilon$, by an electron of energy w_0 in field of a nucleus Ze,

$$d\sigma_0 = \frac{56}{9\pi}\alpha^2Z^2\left(\frac{e^2}{mc^2}\right)^2\log\frac{2\varepsilon}{mc^2}\cdot\log\frac{w_0}{\varepsilon}\cdot\frac{d\varepsilon}{\varepsilon}, \quad . \quad . \quad (1)$$

if $w_0 \gg \varepsilon \gg mc^2$, in harmony with the results of Landau and Lifshitz[2] and of Williams[3].

Møller's primitive interaction is only available,

however, for first order processes: for second order processes it must be modified by an appropriate generalisation of the Bethe and Fermi method[4]. If we introduce this correction, which is equivalent to computing the reaction of the process on the incident electron, we obtain as cross-section

$$d\sigma_1 = \frac{14}{9\pi}\alpha^2 Z^2 \left(\frac{e^2}{mc^2}\right)^2 \log^2 \frac{2\varepsilon}{mc^2}\frac{d\varepsilon}{\varepsilon} \quad . \quad . \quad . \quad (2)$$

Even this cross-section is incorrect, because it neglects the action of the nuclear field on the incident electron, while on the other hand we may suppose that the excess impulse is given to the nucleus by this electron rather than by the rising one. If we calculate the process only with this last nuclear action, we obtain as cross-section

$$d\sigma_2 = \frac{8}{9\pi}\alpha^2 Z^2 \left(\frac{e^2}{mc^2}\right)^2 \log^2 \frac{2\varepsilon}{mc^2}\frac{d\varepsilon}{\varepsilon} \quad . \quad . \quad . \quad . \quad (3)$$

(If we assume Møller's primitive interaction without modifications, $d\sigma_2$ would be small in comparison to $d\sigma_0$ and $d\sigma_1$.)

To obtain the right expression for the cross-section, it suffices to sum $d\sigma_1$ and $d\sigma_2$, because the product of the matrix elements due to the two nuclear actions is antisymmetrical as regards the electron and positron, and vanishes with the integration. We have then

$$d\sigma = \frac{22}{9\pi}\alpha^2 Z^2 \left(\frac{e^2}{mc^2}\right)^2 \log^2 \frac{2\varepsilon}{mc^2}\frac{d\varepsilon}{\varepsilon}, \quad . \quad . \quad . \quad (4)$$

and integrating,

$$\sigma = \frac{22}{27\pi}\alpha^2 Z^2 \left(\frac{e^2}{mc^2}\right)^2 \log^2 \frac{2w_0}{mc^2} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

We see then that even in this approximation, we must neither neglect the reaction of the process on the incident electron, nor the interaction between this electron and the nucleus.

A fuller calculation and discussion of this problem will shortly be published.

GIULIO RACAH.

Istituto Fisico di Arcetri,
Firenze.
July 27.

[1] C. Møller, *Z. Phys.*, **70**, 686; 1931.
[2] L. Landau und E. Lifshitz, *Sow. Phys.*, **6**, 244; 1934.
[3] E. J. Williams, NATURE, **135**, 66; 1935.
[4] H. Bethe und E. Fermi, *Z. Phys.*, **77**, 296, 1932. See also W. Heitler et L. Nordheim, *J. Phys.*, **5**, 449; 1934.

Registration of the Ionisation Curve of a Single α-Particle

IN a recent letter[1], Dr. Alfvén of Uppsala has described a method for measuring the ionisation along the track of individual α-particles. Some years ago, an almost identical method was developed in this laboratory[2] (Fig. 1) and has been used for the investigation of the α-rays from radium and polonium[3]. The main difference between this method and that developed in Uppsala appears to be that, thanks to the oblique direction of the α-rays to the field, with the former method complications from different saturation are largely eliminated. Also the loss of ions to the grid is avoided by the application of a suitable potential. We have, however, of late abandoned this method for others giving more accurate results; namely, for the counting of α-particles and H-particles the "Doppel Rohrenelektrometer"[4], and for exact measurements of the

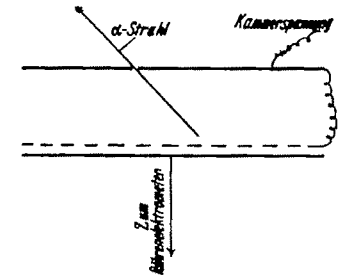

FIG. 1. From *Phys. Z.*, **33**, 294; 1932

specific ionisation along individual α-tracks the method recently published by G. Stetter and W. Jentschke[5], also using a twofold registration.

GEORG STETTER.

II. Physikalisches Institut der
Universität, Wien.

[1] NATURE, **136**, 60, July 13, 1935
[2] G. Stetter, *Phys. Z.*, **33**, 294; 1932.
[3] H. Dannbauer, Dissertation, Universitat Wien
[4] G. Stetter u. J. Schintlmeister, *Wien. Ber.*, **142**, 427; 1933. *Mitt Rad.-Inst.*, No. 322.
[5] G. Stetter u. W. Jentschke, *Phys. Z.*, **36**, 441; 1935.

I AM sorry that I overlooked the papers cited by Prof. Stetter. In excuse I may state that the first paper is published under the title "Eine neue Methode zur Messung der Ionenbeweglichkeit", the second is unobtainable here, the third is published in a journal not very much read, and the fourth was published after my letter was sent to NATURE.

In any event, I do not agree with Prof. Stetter, that my experiment is a copy of his. The main features of the former are:

(1) The ions move with *constant* velocity to a special chamber where they cause a current which is amplified. In some experiments in 1929 I tried to move the ions by a slow air current, but with bad results. In the experiment described in my letter, it is made with a *homogeneous* electrical field. As the grid and the chamber have the same potential in Prof. Stetter's experiment, the field (deriving from the "Durchgriff" only) is not homogeneous. Then the ions do *not* move with a constant velocity and there is no possibility of constructing the ionisation curve from the current to the amplifier.

(2) The amplifier is constructed in such a way that the *current* to the first grid (not its integral) is registered by the oscillograph. Then the ionisation curve is *directly* registered on the oscillogram. In Prof. Stetter's experiment, the registered curve must be differentiated to give the current to the amplifier. In the registrations he has published it seems to be impossible to differentiate the curve with any degree of accuracy.

As regards complications from different saturation and the loss of ions to the grid, I do not think that these are of much importance in an experiment which in any event gives only an approximate picture of the ionisation curve.

HANNES ALFVÉN.

Physics Laboratory,
University, Uppsala.
Aug. 21.

The Fundamental Paradox of the Quantum Theory

THE question of the logical consistency of quantum mechanics has recently been discussed by Prof. G. Temple[1] and by Dr. H. Fröhlich and Dr. E. Guth[2]. Temple arrives at an apparent contradiction, starting from principles which he states to be an essential part of quantum theory. From these principles contradictory results follow, as Temple shows by a perfectly rigorous deduction. (The existence of this deduction seems to have been ignored by Fröhlich and Guth.)

The main assumption used by Temple is that to every function of the classical variables of motion (momentum, co-ordinate, etc.) there corresponds one unambiguously defined operator which may be taken as the representative of this function in quantum mechanics. Although this assumption can be found quite frequently in papers discussing the principles of quantum theory, and even in some text-books, I would like to emphasise that it is not at all necessary and—as one can see from Temple's argument—not even possible in quantum mechanics.

Quantum mechanics requires operators as representatives of physical variables for two purposes: to connect wave functions with experiments, actual or possible, and to calculate the time dependence of the wave function. In order to be able to apply quantum mechanics unambiguously to actual problems, one must, therefore, know (*a*) the operator representing the quantity measured by any given apparatus, and (*b*) the energy operator for any given physical system. Properly speaking, (*a*) is a special case of (*b*), for the properties of a measuring apparatus can always be analysed if its interaction energy with the object in question is known.

If, then, we had an apparatus built in such a way as to measure, say, qp^2q (p denoting the momentum, q the co-ordinate of a particle), this apparatus would be *different* from an apparatus measuring $\frac{1}{2}(p^2q^2 + q^2p^2)$, although in the limiting case of classical mechanics, where quantum effects are negligible, both would measure the same quantity.

Before applying such an apparatus (assuming, for the sake of argument, that it exists although it probably does not) one would have to make sure, either by experimental investigation or by applying quantum mechanics to its working mechanism, which operator actually is to be associated with it. In other words, an apparatus which is quite suitable for measuring a certain quantity in the classical limit may not satisfy our requirements if we rebuild it on a smaller scale, because then quantum effects will have to be taken into consideration.

That one never meets with any difficulty about the order of factors in the usual applications of quantum theory is due to the fact that only very simple operators occur in practice. The most typical of them is the energy of an electron in a field of force, $p^2/2m + V(q)$ (m = mass, V = potential energy). One generally assumes that the function in this exact form, without quantum corrections, has to be taken as the energy operator of a particle the energy of which would be given by the same expression in classical mechanics. This assumption seems very *natural*, but it cannot be *proved* on mere theoretical grounds. All one can say is that this expression is the *most plausible* amongst a variety of different expressions, which all become equal in the classical limit but differ by terms like, for example, $pV - Vp = (h/2\pi i)\text{grad } V$ (h = Planck's constant). It is for the experiment to show that the most plausible choice corresponds to reality and that such correction terms are absent.

That the absence of these correction terms cannot be inferred from mere theoretical considerations is proved by the fact that when relativity and spin corrections are taken into account, such terms actually *do occur*.

R. PEIERLS.

Physical Laboratory,
University, Manchester.
Aug. 5.

[1] NATURE, 135, 957, June 8, 1935.
[2] NATURE, 136, 179, Aug. 3, 1935.

Uncertainty Principle and the Zero-Point Energy of the Harmonic Oscillator

ACCORDING to quantum mechanics, an oscillator possesses a definite zero-point energy of vibration, and an attempt has been made to express this result *directly* in terms of some general principle. It has been found that the result may be deduced from the uncertainty principle, in view of the particular relation between position, momentum and energy in a simple harmonic field.

In a state of zero energy the vibrating particle would be at rest at the centre of the field, and its position and momentum would both be known accurately. But this would contradict the uncertainty principle, and the state is therefore not possible. The value of the minimum energy may be calculated from the uncertainty relation $\Delta p\ \Delta q \geqslant h/2\pi$. The linear harmonic oscillator is defined by the energy equation

$$W = \tfrac{1}{2}\mu\omega^2q^2 + \tfrac{1}{2}p^2/\mu = \text{constant}.$$

If we interpret

amplitude of $q = \Delta q$ = uncertainty in position,
amplitude of $p = \Delta p$ = uncertainty in momentum,

then $W = \frac{1}{2}\mu\omega^2(\Delta q)^2 = \frac{1}{2}(\Delta p)^2/\mu$,
giving $\mu\omega\,\Delta q = \pm\ \Delta p$.

For real Δp the positive sign must be taken, and from the uncertainty relation, $(\Delta p)^2 \geqslant h\mu\omega/2\pi$, and therefore $W \geqslant \frac{1}{2}h\omega/2\pi$. Taking the equality sign for the least value of the energy, it follows that the zero-point energy is $\frac{1}{2}h\omega/2\pi$.

R. A. NEWING.

Department of Applied Mathematics,
University, Liverpool.
June 22.

The Problem of a Plant Virus Infection

IN a recent publication[1] an account was given of a new virus disease which occurred spontaneously in tobacco plants growing under insect-proof conditions in sterilised soil and sand. It was shown that the cowpea (*Vigna sinensis*), on account of its extreme sensitivity to the virus, was a valuable experimental plant. In continuing studies upon this disease, some observations have been made which will be of interest to virus workers.

It has been found by inoculation tests that a high percentage of healthy tobacco plants of the variety White Burley carry the virus in the roots. These plants are absolutely normal in appearance and under the present conditions of light and temperature in

the glasshouses remain normal until mature. Careful tests have failed to demonstrate the presence of the virus in the stems and leaves of young tobacco plants which are carrying the virus in the roots. The virus has, however, been isolated on one or two occasions from the stems of old, apparently normal, tobacco plants.

It therefore appears that a large proportion of tobacco plants of the White Burley variety normally carry a potential virus disease within them, and it is thus possible to inoculate a perfectly healthy plant from its own roots and to produce thereby severe, though localised, virus symptoms. Visible disease symptoms develop naturally in tobacco seedlings in the glasshouses from November until April, but have not been observed during the summer.

Further, and this is the most interesting point, there is a good deal of evidence that the same young tobacco plants which, by available inoculation methods, have been shown to be virus-free, yet contain the virus in the roots in quite large quantities some five or six weeks later.

The following experiment illustrates this. Seed from a White Burley tobacco plant grown in the insect-proof glasshouse was sown in sterilised sand in a 'cellophane' cage in the glasshouse. From the resulting seedlings a number of small plants were chosen and all the roots cut off except that one root was left on each plant. The roots of each plant, thus removed, were ground up and the resulting paste inoculated separately to three or four cowpeas. The tobacco plants were then repotted in sterilised soil and allowed to grow on; from this number twenty-four plants, the roots of which had given no reaction on the cowpeas, were selected for a second test. This was made, again to cowpeas, five weeks after the first test. The plants were by this time about eight inches across with a well-developed root system and showed no unusual symptoms. Of these twenty-four plants, on the second test, the roots of only five were found to be virus-free. The roots of the others gave a virus reaction ranging from twenty-five lesions, on five cowpeas out of five inoculated, down to a single virus lesion.

In considering these results, certain other facts should be borne in mind; exhaustive tests make the possibility of outside infection by seed-, soil-, or water-transmission unlikely, though seed transmission in some form cannot be definitely excluded. The virus is not insect borne. Further, it should be emphasised that natural infections of the virus have not occurred on any plant other than the tobacco, *Nicotiana tabacum*, and, occasionally, on *Nicotiana glutinosa*. Plants like cowpea, *Datura* and tomato have never once in five years become naturally infected in the glasshouse, although growing alongside virus-containing tobacco plants. Yet these species, especially the cowpea, are very susceptible to artificial inoculation with the virus.

Other properties of the virus which may have a bearing on the problem are its lack of resistance—it only remains viable in extracted sap for about 20 days—its low dilution end-point of 1 : 10,000 and its inability to withstand desiccation. The virus is of very small size; the average particle diameter is only 20–30 mμ as measured by the Elford process of ultra-filtration. Finally, there is the tendency of the virus to remain localised in the host whether the infection is natural or artificial and whatever the species of host plant. This fact also militates against the probability of seed transmission of the virus.

There seem to be three possible explanations of this problem. First, it may be assumed that the virus is present all the time in the stem, but present either in a non-virulent form which requires to gain virulence by concentration in particular cells of the roots or else in a dilution too great to give a positive reaction on inoculation. This theory, of course, involves seed transmission of the virus in undetectable form or quantity. The second possible explanation is that the virus is arising spontaneously within the plant. The third possibility, and perhaps the least likely, is the existence of a mode of virus transmission quite unknown to plant virus workers.

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Potato Virus Research Station,
School of Agriculture,
and Molteno Institute,
Cambridge.

[1] Smith and Bald, *Parasitology*, 27, 2; 1935.

Non-identity of Vitamin D_2 (Irradiated Ergosterol, Calciferol) and the Natural Vitamin D from Cod Liver Oil

As will be known from numerous papers, these two forms of vitamin D have different biological actions. In children and in chicks, one rat unit of the natural vitamin D of cod liver oil is about a hundred times as potent against rickets as one rat unit of irradiated ergosterol. Hence Steenbock[1] has concluded that the two substances are not identical. Chemical and physical proofs of the difference between the two substances have been advanced by Ender[2], who showed that vitamin D_2 differed from the natural vitamin D in its reaction with phthalic anhydride, its ultra-violet spectrum and its rotation of polarised light. As basic material, Ender used the liver fat of the tunny (*Thunnus Thynnus*) on the assumption that the vitamin D in various fishes is the same. However, Bills, Massengale and Imboden[3] have found that one rat unit of Blue-fin tunny liver oil in chicks has only 15 per cent of the antirachitic effect of one rat unit of cod liver oil, whence they conclude that the two forms of vitamin D are different.

We have therefore made comparisons between the vitamin D from cod liver oil and irradiated ergosterol (D_2). The former was concentrated by the methods described by Rygh[4] and Weidemann[5]. The vitamin A was eliminated by the method of Dalmer, v. Werder and Moll[6]. 200 kgm. of cod liver oil yielded 8 gm. of a concentrate containing 3×10^6 international units vitamin D per gram. The original oil contained 150 international D-units per gram; the vitamin D had thus been concentrated about 20,000 times. The results of the comparisons are stated below, where also the results of Ender with tunny liver oil are quoted:

	D_2	D-concentrate of cod liver oil	D-concentrate of tunny liver oil
Ultra-violet spectrum	Max. 265 mμ	No max. 260–270 mμ	No max. 260–270 mμ
$[\alpha]_d$ in alcoholic solution	+ 103°	± 0°	± 0°
Per cent esterification with phthalic anhydride and pyridine after 10 days	about 30	100	100
Effect of maleic anhydride	none	none	none
Monohydric alcohol	+	+	+

The data are not sufficient to determine whether

vitamin D from cod liver oil and from tunny liver oil are different or identical. But they show that both these forms of vitamin D are different from irradiated ergosterol.

OTTAR RYGH.

State Vitamin Institute,
Skøyen, Oslo.
Aug. 6.

[1] *J. Biol. Chem.*, 97, 249, 1932.
[2] *Z. Vitaminforsch.*, 2, 241; 1933.
[3] *Science*, 80, 596; 1934.
[4] *Bull. Soc. Chim. Biol.*, 16, 609; 1934.
[5] *Biochem J.*, 20, 685; 1926. 26, 264; 1932.
[6] *Hope Seylers Z. Physiol. Chem.*, 224, 86; 1934.

Abnormal Magnetic Behaviour of Treated Cobalt Wire

THE magnetisation curve was determined for a length of cobalt wire of 0·194 in. diameter in the condition as received and the result is shown by the curve *A* in Fig. 1. In this figure the values of $4\pi I$, that is, the 'metallic magnetic density', are plotted against the magnetising force as abscissæ. The maximum permeability of the wire in this condition was found to be 100, the corresponding value of H being about 35 oersteds.

The wire was then heated by passing an alternating current through it in an atmosphere of hydrogen, and the current was of sufficient strength to raise the temperature of the wire quickly to about 1,200° C., this temperature being maintained for a few seconds. The magnetisation curve was obtained after the wire had cooled down, and the result is shown by curve *B* in Fig. 1. The maximum permeability in this case was found to be 370, the corresponding value of H being 7 oersteds. So far as I am aware, this is the highest value for the permeability of cobalt at room temperature which has yet been recorded.

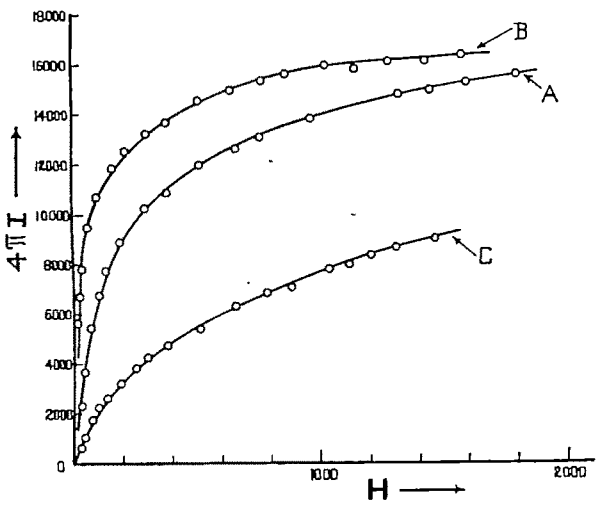

FIG. 1.

The wire was next placed in an atmosphere of hydrogen and an alternating current of frequency 50 was passed through it for several hours, the current being such that the temperature was maintained at about 1,200° C. After the wire had cooled down, the magnetisation curve was again obtained and is shown by curve *C* in Fig. 1. The striking features of this curve are that the saturation metallic density would appear to be only about 60 per cent of that of the normal cobalt, whilst the maximum permeability is now only 30.

The treatment is being continued to find out to what magnetic condition the wire will eventually settle down, and similar investigations are being made for iron and nickel wires.

T. F. WALL.

Department of Electrical Engineering,
The University,
Sheffield.
Aug. 6.

Unit of Force in the M.K.S. System

THE decision of the International Electrotechnical Commission to recommend the use of the M.K.S. system of electrical, mechanical and magnetic units, as reported in NATURE of July 6, may have far-reaching consequences, for experience has shown that a unit in daily use by engineers soon becomes a familiar quantity, and as such is preferred for quantitative work even by the pure physicist. The statistical examination of the question by G. A. Campbell[1] shows this very clearly: the practical units, volt, ohm, ampere, coulomb, etc., are used by the pure physicist far more than the corresponding C.G.S.M. or C.G.S.E. units. Since the M.K.S. system also possesses advantages for mathematical work, it is at least possible that it may ultimately become universally used.

This possibility will be very considerably increased if all the units have convenient names. In the M.K.S. system, the unit of energy is the joule, and the unit of power is the watt, but no name has yet been assigned to the unit of force, the force which, acting on a mass of 1 kilogram, gives it an acceleration of 1 metre per sec. per sec. G. Giorgi[2] has provisionally used the word 'vis' but the 's' ending makes the use of the plural awkward. Moreover, the derivation of the word is not in conformity with the derivation of the names of the closely related units of energy and power, which have been called after famous men of science. We venture to suggest that 'newton' would be more appropriate. The name of Newton is universally associated with the idea of impressed force, the word complies with the suggestion of G. A. Campbell[1] that the name chosen should have no more than two syllables, and as Newton's name cannot but occur again and again throughout the teaching of even the most elementary mechanics, pronunciation should present no difficulty in other countries.

We understand that the unit of magnetic flux has been called the 'weber'. If the ampere-turn be adopted as the unit of magnetomotive force, which means that the system would be rationalised, then no additional names for units would be necessary. This is certainly not the strongest of arguments for rationalisation, but we would emphasise the importance of easily remembered names with no risk of confusion, and would deprecate the use of a unit for H which would require yet another new name. Although a definite ruling on the use of the C.G.S.M. units, the gilbert, gauss, oersted and maxwell has been given, there is still confusion between them in published papers.

L. HARTSHORN.
P. VIGOUREUX.

National Physical Laboratory,
Teddington, Middlesex.
Aug. 12.

[1] *Bull. Nat. Res. Council*, No. 93, 48; 1933.
[2] Intern. Electrotech. Commission, Memorandum on the M.K.S. System of Practical Units.

Upper Carboniferous Fossils in America and Europe

THE interesting note by Prof. A. E. Trueman in NATURE of June 29, p. 1074, recalls to mind some studies of Upper Carboniferous cockroaches, which I made a number of years ago. The results are fully set forth in *Annals and Magazine of Natural History*, April 1927, but it is now pertinent to quote (p. 393):

"The typical Mylacridæ (using this expression to exclude the series related to *Hemimylacris*) abounded in America throughout Allegheny time, yet never, so far as we know, reached Europe. This suggests that the Blattid faunæ of the two sides of the world were not intermingled to any extent during that period, and makes it rather improbable that various Archimylacrid genera crossed over, though they may have done so prior to the rise of the Mylacridæ."

It is possible that land connexions northward were utilised by the plants, but were not usually available to the tropical or subtropical cockroaches. It is also possible that various types of plants did not appear simultaneously on both sides of the world, but developed first on one side and eventually reached the other. But all these matters require more detailed discussion, which is impossible here.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado.
July 21.

Methylene Blue as a Stain for Mucus

IN spite of a somewhat adverse criticism, and a statement apparently to the contrary[1], methylene blue is one of the best and easiest stains for mucus. According to Bolles Lee, "Microtomist's Vademecum", p. 497 (ninth edition), *Methylene blue is particularly useful from its power of bringing out the merest traces of mucin*, while the following very simple experiment illustrates this.

A few specimens of the common snail (*Helix aspersa*) are collected and placed on small pieces of glass. They soon crawl off leaving a trace of mucus. If the pieces of glass are placed, without further treatment, in a 0·01 per cent aqueous solution of methylene blue the mucus stains a deep blue within two minutes.

Chirocephalus lives apparently quite comfortably in this solution for an hour, and long before that time patches of mucus or a mucus-like secretion appear deeply stained within the median groove.

A. G. LOWNDES.

Marlborough College,
Wilts.

[1] Cannon, H. G., "A Further Account of the Feeding Mechanism of *Chirocephalus diaphanus*", *Proc. Roy. Soc. Lond.*, Series B, No. 806, 117, 455–470; June 1935.

[2] Lowndes, A. G., "The Feeding Mechanism of *Chirocephalus diaphanus*, Prévost, the Fairy Shrimp", *Proc. Zool Soc. Lond.*, 1110; 1933.

Points from Foregoing Letters

MRS. BARLOW quotes from Darwin's unpublished manuscripts, dealing with the fauna of Galapagos Islands, to show that so early as 1837 Darwin had begun to doubt the stability of species.

On removal of the xylan from manilla hemp cellulose fibres, X-ray photographs have been obtained which indicate a more perfect state of crystallisation, and are similar to photographs of fibres of low xylan content. W. T. Astbury, Dr. R. D. Preston and Dr. A. G. Norman state that this is compatible with the view that the association of the xylan with cellulose is a mixed crystallisation.

Dr. W. H. George submits a photomicrograph of an etched surface of a crystal of copper (grown by the Bridgman method). Its appearance, similar to that of polycrystalline metals, suggests that the crystal has broken down into a large number of small ones; X-ray photographs show that their orientation has remain unchanged.

New measurements, in vacuum, of the changes in magnetic susceptibility of tin, copper, silver and gold, during allotropic transformation or melting, have been made by Prof. K. Honda and Y. Shimizu. To check Honda's theory, they compared the experimental values with those obtained by adding the change in paramagnetic susceptibility calculated according to the equation of Pauli, Landau and Posener, to the change in diamagnetic susceptibility from the formula of Sommerfeld and Hirone.

Prof. G. Racah discusses the cross-section for the production of pairs of positive and negative electrons by collisions between electrons and nuclei. He submits several approximate formulæ and concludes that both the reaction of the process on the incident electron and the interaction between this electron and the nucleus must be taken into consideration.

Many papers discussing the principles of quantum theory have assumed that to every function of the classical variables there corresponds one unambiguously defined quantum operator. This assumption, writes Dr. R. Peierls, is not necessary in quantum theory, and consequently the paradox pointed out by Prof. Temple can be obviated.

From the uncertainty principle, which states that the position and momentum of a particle cannot both be known accurately at a given time, R. A. Newing calculates the zero-point energy of the harmonic oscillator to be equal to $\frac{1}{2}h\omega/2\pi$.

Dr. Kenneth Smith describes the occurrence of a virus in the roots of a high proportion of normal tobacco plants. The virus appears in the plants under conditions which are usually considered virus-proof. Three possible explanations of the problem are discussed.

The ultra-violet absorption, optical rotation and certain chemical reactions of synthetic vitamin D are found by Dr. O. Rygh, of the State Vitamin Institute, Oslo, to differ from those of vitamin D prepared from cod liver and tunny liver oil. The author concludes that synthetic vitamin D (obtained by irradiating ergosterol) is chemically different from the natural product, which may explain the reported discrepancy in their potency as a cure for rickets in children.

A cobalt wire was heated for some hours to about 1,200° C. in an atmosphere of hydrogen by an alternating current at frequency 50. After the wire had cooled down, Dr. T. F. Wall finds that the saturation value of the intensity of magnetisation was only about 60 per cent of that for the normal cobalt.

The word 'newton' rather than 'vis' is suggested by Dr. L. Hartshorn and P. Vigoureux as a name for the unit of force in the M.K.S. system, that is, for the force which, acting upon a mass of one kilogram, gives it an acceleration of one metre per sec. per sec.

Research Items

Culture Areas in Nigeria

MR. WILFRID D. HAMBLY, as leader of the Frederick H. Rawson-Field Museum Ethnological Expedition to West Africa, 1929–30, has made a cultural survey of Nigeria based upon a synthesis of the evidence of physical characters, language, social and material culture, also taking into account geographical factors (Field Museum of Natural History Pub. 346, Anthrop. Ser., 21, No. 3). Broadly, the country falls into three regions—southern, northern and an intervening plateau area. South of lat. 9° N., negro somatic traits prevail; north of that line modifying physical characters are to be noted, and the farther north the more strongly are negro traits overlaid until on the border of the Sahara the type is definitely non-negro. The intruding elements are Hamitic and Semitic. In linguistics the two main divisions are Bantu-speaking and Sudanic-speaking, the main languages north of lat. 9° N. being Hamitic and Semitic, supplemented by Sudanic negro languages. Culturally, there is a type of culture which is fundamental to the whole of Nigeria, though the negro elements are more deeply entrenched south of the line of 9° N. Allowing for local differentiation there is, in fact, in West Africa a predominating uniformity in the pattern of forest negro culture through Liberia, the Ivory Coast, Ashanti, Dahomey, Nigeria, Cameroon and the Congo Basin, into the land occupied by the Ovimbundu of Angola. Among such elements are, for example, skill in ironwork, wood and ivory carving, pottery made by coiling and punching, bark cloth, hoe cultivation by women, and in the social life similarly certain fundamental elements are to be noted. Foreign elements superimposed on the negro culture are Hamitic, Semitic, Mediterranean and European. These are found more especially in the north and are associated with occupations centring in the keeping of camels, horses and cattle. In the plateau area, on the other hand, are cultural pockets, which preserve modes of life that are probably of early negro character.

Marriage among Aimol Kukis, Assam

IN the course of a study of the social organisation of the Aimol Kukis of Assam, by Mr. J. K. Bose (*J. Depart. Letters*, Calcutta Univ., 25), it is indicated how changes in social conditions have affected and modified the regulation of marriage. The Aimol Kukis were at one time organised in a dual division, in which it was the rule that members of the superior moiety should marry in the inferior moiety. Nowadays, one of the clans in the inferior moiety is practically extinct, and the people of the superior moiety, now greatly in the majority, experience great difficulty in finding a suitable mate. Although they are strictly exogamous, they are thus forced to abandon the practice of marrying in the opposite moiety, and must wed within their own moiety, still, however, strictly avoiding marriage within the clan or its subdivisions. Another modification, which is being introduced, by outside contacts, is that of payment for the bride by money instead of the three years service by which formerly the bridegroom earned from the bride's family the right to return with her to his own village. This form of marriage by service was that which was most generally recognised, and even now purchase is only beginning to be introduced among the more well-to-do. Four other forms of marriage are admitted: elopement, when the parents do not like the marriage upon which the parties concerned have agreed between themselves; capture, which takes place when a young man, having served for a period of, say, a year, is driven out by his future father-in-law for no serious cause; marriage of a widow, usually by a younger brother of the husband, no ceremony taking place or price being paid; and mutual settlement between the parties to live together without any marriage ceremony, when a fine is imposed by the girl's father for the loss of his daughter.

Survival in Tree-Swallows

THE very great efficiency of nesting in the tree-swallow of the United States of America (*Iridoprocne bicolor*), under not quite natural conditions, is illustrated by the observations of Winton Weydemeyer (*Condor*, 37, 216, July 1935). For eight seasons he has kept records of the nesting activities of tree-swallows making use of bird-houses erected by him, and occupied yearly by eight to sixteen pairs. Full records of 60 nests, 52 of which were first brood nests, 8 second broods, show that the former contained 324 eggs, the latter 39. Of these there hatched 319 and 39; six nestlings of the latter died, and 12 of the former were taken by a sparrow-hawk; but of the total number of nests, in 44 out of 52, and 6 out of 8 their total clutch was raised without loss. Including all accidentals, of failure to hatch and so on, the efficiency of the nests studied is represented by 94·7 per cent of survival in the case of first broods and 84·5 per cent in the case of second broods.

A Warty Growth on the Head of Land-Snails

I. TAKI (*J. Sci. Hiroshima Univ.*, 3, 1935) directs attention to a peculiar warty structure on the head, between the two posterior tentacles, of adult snails belonging to the family Cepolidæ, and to a concavity, containing three to twenty tubercles, in a corresponding position in the family Pleurodontidæ. The head-wart consists of a number of modified dermal tubercles, in two genera in a single sinuous row, but in all others forming a group of various sizes and shapes. The head-wart has a particularly thick epithelium and its interior is occupied by connective tissue in which are fibrils, chromatophores and blood-lacunæ. The rudiment of the head-wart is visible in the early stages of development of the snail; the wart attains its full size by rapid growth at the time of sexual maturity. In the breeding season the head-wart in certain genera forms a conspicuous hemispherical protrusion; external stimuli cause its contraction. The protrusion of the wart is effected by increase of pressure of the blood, which takes place before copulation. From the position of the head-wart, its rapid growth at sexual maturity and its swelling, it is inferred that the wart has some bearing on the sexual activity of the snail, though it is not clear how it functions.

Host Selection by Insect Parasites

G. SALT (*Proc. Roy. Soc.*, B, 117, 805; 1935) has investigated the process of selection of host-species by the ovipositing females of a small chalcid parasitoid, *Trichogramma evanescens*. Ovipositing females were observed to examine, select and attack, besides a number of true hosts (such as the egg of the Angoumois grain-moth, *Sitotroga cerealella*) from which their progeny successfully emerged, several unsuitable hosts in which their progeny were unable to develop, and a variety of false hosts, such as particles of sand and globules of mercury, in which they were not able even to lay their eggs. Two strains of *Trichogramma* reared exclusively on *Sitotroga cerealella* and the Mediterranean flour-moth, *Ephestia kuehniella*, respectively for 63 and 43 generations, developed no dependence on or even preference for their respective hosts. Both strains preferred eggs of *Ephestia*, but an analysis of the preference showed that it was not a specific preference for *Ephestia* but a preference for it simply as the larger host. When two different kinds of hosts were simultaneously exposed to *Trichogramma* the latter showed a preference for the larger of the two, even though the preferred host was unsuitable for the development of its progeny or was a false host in which the parasite could not even lay its eggs. Size appears to be the principal criterion used by ovipositing females of *Trichogramma* in the selection of their hosts.

Vessel-less Dicotyledons

THE anatomy of the four homoxylous genera of Angiosperms, *Drimys*, *Zygogynum*, *Tetracentron* and *Trochodendron*, has been re-examined by K. M. Gupta, University of Lucknow (*J. Indian Bot. Soc.*, 13, No. 1, 1934). He points out that they may be sharply divided into two groups: (1) *Drimys* and *Zygogynum*, with several species distributed in Australian and South American regions; and (2) *Trochodendron* and *Tetracentron*, monotypic genera confined to Japan and China respectively. In the *Drimys* group the growth rings are absent or faintly marked, the rays scarcely or not at all enlarged at the junction of the growth rings, the ray cells uniformly pitted on radial and tangential walls and the pitting on the tracheids of the spring wood is of the multiseriate type. In the *Trochodendron* group, growth rings are well marked and the rays enlarged at the junction of the growth rings, and the pitting of the tracheids of the spring wood is scalariform. He also points out that all four genera can be distinguished by the shape of the ray cells as seen in tangential longitudinal sections. The anatomical data are briefly used in a discussion of the vexed problem of the origin of the Angiosperms but, apart from emphasising the importance of the Magnoliales in connexion with this problem, the theoretical significance of these vessel-less dicotyledons still remains obscure.

English and Canadian Tomato Virus Diseases

THE presence in England of Dr. G. H. Berkeley, a Canadian plant pathologist, has been put to considerable profit in the elucidation of difficulties of virus disease nomenclature. A co-operative study has been made with the Rothamsted and Cheshunt Experimental Stations ("A Comparison of English and Canadian Tomato Virus Diseases" by Drs. G. C. Ainsworth, G. H. Berkeley and J. Caldwell, *Ann. App. Biol.*, 21, No. 4, 566–580, Nov. 1934). Seven distinct viruses have been studied, namely: tomato mosaic, yellow mosaic, single-virus streak, mixed-virus streak, ring mosaic, tobacco virus No. 9, and spotted wilt. The last-named disease apparently does not occur in Canada, whilst ring mosaic and the No. 9 virus have not yet been recorded in England. Mixed-virus streak is not common in England, but the other viruses mentioned above are relatively common in both countries.

Virus Diseases of Ornamental Plants

DR. KENNETH SMITH has published a paper on "Some Diseases of Ornamental Plants caused by the Virus of Tomato Spotted Wilt" (*J. Roy. Hort. Soc.*, 60, Part 7, July 1935). The disease on the tomato causes the leaves to curl downwards and inwards, whilst bronze-coloured spots, with an almost metallic lustre, appear upon the leaflets. Many other garden plants are attacked, including the Iceland poppy, various stocks, tropæolum, begonia, several plants belonging to the Compositæ, campanula, calceolaria, gloxinia, arum, hippeastrum, and more than a dozen species of Solanaceæ. Symptoms vary on each of these hosts. *Thrips tabaci* is the only insect concerned in distribution of the malady, and destruction of this pest, along with the removal of infected plants, are the chief methods of control advocated in the paper.

Molasses and Nitrogen Fixation in Soil

IN two recent publications, N. R. Dhar and S. K. Mukerji (*Proc. Acad. Sci. U.P., India*, 4, 175; 1934; 330; 1935) have shown that when cane sugar is added to sterilised or unsterilised soil and exposed to light and air, there is an appreciable increase in the ammoniacal nitrogen content; with unsterilised soils the ammoniacal nitrogen is nine times greater than that originally present in the soil. With sterilised soil it is about three times as great. The amount of ammonia in presence of light is always greater than in the dark. By the addition of molasses to soils which have been properly aerated, the ammoniacal nitrogen may become three times as great as that originally present in the soil. When the aeration of the soil is less, the increase of ammonia is less and the soil becomes acidic. It appears that in tropical countries in ordinary soils, the fixation of atmospheric nitrogen by the addition of energy-rich compounds is partly bacterial and partly photochemical. The oxidation of the energy-rich organic compounds by air either by chemical induction, light absorption or bacterial action causes the fixation of the atmospheric nitrogen in the soil. These researches may be of considerable practical importance, because the molasses available in the sugar factories in India are wasted at the present time.

The "Amal" Bunsen Burner

THIS new type of laboratory burner, which was briefly described in NATURE of December 1, 1934, has been improved by the inclusion of a pressure-damping device which, by proportioning the flow of gas to the size of the jet orifice, enables the flame to be turned down still lower than was previously possible; and also by the provision of a set of detachable heads. These provide a horizontal rose flame, horizontal and vertical batswing flames, the fully aerated bunsen flame and, for the smaller burner only (the "Amal minor"), a dental head that gives a rotatable flame projecting at a convenient angle so

that molten material cannot drop into the burner and choke the jet, this flame being convertible at will into a luminous flame by putting on a small tip. The head giving the vertical batswing flame contains a small hole providing a tiny hot flame for 'spot' heating. The Amal burner possesses all the advantages and more of the Meker and Teclu burners, and also all those of the ordinary 'bunsen' except the control of air-supply. A further adaptation is the "Amal" petrol-gas burner, which works well on the gases from Silverlite and Aerogen plants. It resembles the town's gas burner, but has only one hole for admitting secondary air, and this is regulated by a spring band clip.

Mandelic Acid: a Urinary Antiseptic

INFECTIONS of the urinary tract are troublesome and serious complaints that frequently fail to yield to ordinary treatment. A ketogenic diet has been found to be curative, and A. T. Fuller (*Lancet*, **1**, 1933 855;) showed that under it β-hydroxybutyric acid is formed, appears in the urine, and is the actual bactericidal agent. This acid cannot, however, be given orally, as it becomes oxidised in the body before excretion. A ketogenic diet, moreover, requires careful and institutional supervision, and is also not tolerated by all patients. Seeking for a substitute, M. L. Rosenheim (*Lancet*, **1**, 1935) 1032; tested numerous keto- and hydroxy-acids allied to β-hydroxybutyric acid, and found that mandelic acid best realises the conditions necessary, for it is excreted unchanged, is non-toxic in therapeutic doses, and is bactericidal in an acid urine to *Bacillus coli* and other organisms that may infect the urinary tract. In order to ensure an acid condition of the urine, ammonium chloride is given with it. Mandelic acid is a white crystalline powder, readily soluble in water, and is now being manufactured by Messrs. Boots Pure Drug Co., Station Road, Nottingham, from whom particulars may be obtained.

Preparation of Silanes

ALTHOUGH monosilane, SiH_4, was prepared by Buff and Wöhler in 1857 and its physical and chemical properties have been exhaustively investigated by Stock and co-workers since 1916, the method of preparation has been unsatisfactory. Stock allowed magnesium silicide, prepared by the reduction of silica with magnesium at high temperatures, to drop into aqueous hydrochloric acid, when a mixture of gases was evolved containing 40 per cent SiH_4, 30 per cent Si_2H_6 (disilane), 15 per cent Si_3H_8, 10 per cent Si_4H_{10} and 7 per cent higher compounds. Only 23 per cent of the silicon in the magnesium silicide appeared as gaseous hydrides. In 1934, Kraus and Carney reported a very convenient and efficient method of preparation of hydrides of germanium, giving yields of more than 60 per cent by dropping ammonium bromide into a suspension of magnesium germanide in liquid ammonia, the ammonium salt behaving as an acid in somewhat the same manner as hydrochloric acid in aqueous solution. W. C. Johnson and S. Isenberg (*J. Amer. Chem. Soc.*, **57**, 1349; 1935) now find that this method may be used to obtain high yields of silanes, varying from 70 to 80 per cent. Magnesium silicide was prepared by heating finely divided silicon with magnesium filings at 475°–1,000° in an atmosphere of hydrogen. The fine blue powder so obtained was dropped into a solution of ammonium bromide in liquid ammonia and the gas evolved passed through slightly acidified water and then dried with phosphorus pentoxide and condensed in liquid nitrogen. The product was then fractionally distilled. It was found that pyrex stopcocks lubricated with vacuum grease were satisfactory, and that it was not necessary to use mercury valves in manipulating the gases. The physical properties of the mono- and disilanes agreed with those found by Stock and co-workers. It was found that 50 per cent ferrosilicon did not react with ammonium bromide in liquid ammonia unless first heated with magnesium filings, when an unusually high yield of disilane was obtained.

Crane Hooks, Links, etc.

AMONG the papers selected by the Council of the Institution of Mechanical Engineers for publication in *Proceedings* is a contribution by Messrs. Gough, Cox and Sopwith, on the "Design of Crane Hooks and other Components of Lifting Gear". These components consist in the main of curved beams, made of ductile material, of which the radii of curvature are, usually, relatively small. They are distinguished by very complex stress distributions, and have been the subject of various theories from which and from much accumulated practical experience their makers have evolved methods of design giving safe but not, in the opinion of the authors, economical results in practice. The National Physical Laboratory and the British Standards Institution have been engaged in research, standardisation and specification in connexion with this group of lifting gear components with the results reported in the paper now issued. The effect of the curvature of the centre line is first discussed, then that of local yielding, and it is shown that, when this occurs, the removal of the load results in a reversal of stress in the locality of the set. The calculated elastic stresses thus become, in service, ranges of stress as the component is loaded and unloaded, and the material is called upon to withstand the calculated stress as a range which should not exceed the numerical sum of the yield stresses in tension and compression. The method of calculating the bending moment in rings, links, etc., is shown, with comparisons between approximate and exact methods, and general formulæ are obtained for egg links, studded links and eye-bolts, typical examples from recent British Standard Specifications being worked out.

Spectrum of a Hot Carbon Star

THE spectrum of the irregular variable star *R* Coronae Borealis has been studied in detail by L. Berman (*Astrophys. J.*, **81**, 369) in three-prism spectrograms taken at the Lick Observatory. The wave-lengths of about 650 lines have been measured over the region 4300–4900 A., and the absolute numbers of atoms engaged in their production deduced from observed line intensities and theoretical intensity ratios of supermultiplets. Carbon is found to be abnormally abundant, and constitutes 69 per cent of the atmosphere of this star, the remainder of which is composed of 27 per cent hydrogen, 4 per cent metals (chiefly magnesium and iron), and less than 0·3 per cent nitrogen. The effective temperature of the star is computed to be 5300° K.; the colour temperature in the blue is about 1,000° higher, and in the red about 1,000° higher still, though the last result may be vitiated by the difficulty of defining the true continuous background in this region.

Imperial Botanical Conference

THE Imperial Botanical Conference which met on August 27–30 in the rooms of the Linnean Society, Burlington House, London, is the third of a series which dates from the years immediately following the War. At that time, the International Botanical Congresses, initiated in pre-War years, which were due to be held at five-yearly intervals, were in abeyance. Thanks to the efforts of a committee of British botanists a conference of Empire botanists, on a scale fairly comparable to that of an International Congress, was arranged for the year 1924, and took place in London. Quite apart from its value to scientific botany generally and to the advancement of botanical study within the Empire in particular, that Conference undoubtedly acted as a stimulus to the resumption of normal friendly relations between European botanists which had been sadly interrupted.

Now that the International Congresses are again established—first at Ithaca, N.Y., in 1926, then at Cambridge in 1930, and in the present year at Amsterdam—the need for Imperial Conferences has to some extent disappeared, at least from the point of view of general botanical science. It was felt, however, that such conferences would still serve a useful purpose in relation to problems of special Imperial interest, to the organisation of research, and not least to the formation of contacts between widely scattered groups of workers. A small committee was therefore kept in being. A short conference, of a purely formal nature, was held in 1930, and now the third of the series has taken place. The subjects for discussion were limited to those of general economic interest to the Empire, and were in the main suggested by botanists overseas.

In his address of welcome to members, the president, Sir Arthur Hill, emphasised the ever-increasing importance of botanical research in the development of Imperial agricultural resources, not merely with regard to crops which figure in export trade, but also to the food plants of the native and his animals. The study of native crops with the view of obtaining maximum yields under the various local conditions is a work of the greatest national importance which calls for the continued co-operation of botanical and agricultural workers at home and overseas.

Pasture Research

Prof. R. G. Stapledon, in introducing a series of papers on "Pasture Research Within the Empire", dealt with the importance of 'strain' in pasture plants. Studies at Aberystwyth have abundantly shown that grassland plants are no exception to the general rule that botanical species contain within their ambit a more or less indefinite number of strains or varieties. Between the strains of a particular grass or clover there might be a greater difference in agricultural value, for example, permanence in the pasture, feeding value, economic return, etc.—than there is between desirable and undesirable species. These strains or groups of strains have been evolved on a geographical basis, partly in response to climatic and soil conditions, but probably to a large extent as a result of long-continued farming practices. The work of the plant breeder is in the first place to discover which are the most desirable of these local groups for special purposes, and then to ensure that in commercial exploitation any tendency to deterioration is effectively checked. The sowing out of pure strains is not desirable inasmuch as a certain degree of variability gives some insurance against the vagaries of climate and of farming practice. The maintenance of pure strains, with subsequent judicious blending, is a splendid ideal which is very difficult to achieve and is in fact not necessary. The difficulty of maintaining the quality of a certain group of strains ('ecogroup') is not so great as is sometimes imagined and can be overcome for all practical purposes if the work is carried out in a suitable locality and on a large enough scale. The essential point is to safeguard the quality of the original stock, and this can only be done under the direct control of the plant breeding station.

The problems involved in the improvement of pastures in the Dominions were outlined by Dr. I. B. Pole-Evans for the Union of South Africa, and by Prof. G. W. Scarth and Mr. H. J. Whyte for eastern Canada. Dr. Pole-Evans described the natural pasture areas of the Union, and in this connexion exhibited a comprehensive series of coloured plates illustrative of the South African flora. Much damage to natural pastures has already been done by indiscriminate grazing, by burning and by other malpractices. This he ascribed to a general absence of fundamental knowledge relating to the problems of veld management. He reviewed the research work which has been carried out in the Union up to the present and stated that a national research programme has now been organised which will deal in particular with problems relating to the general decline in the carrying capacity of the veld due to faulty grazing methods. This programme will also aim at the building up of an organised animal industry based on the development of the natural pasture potentialities of the country.

In presenting the Canadian problems, Prof. Scarth pointed out that the natural pastures of eastern Canada are at the moment the most important in the Dominion, inasmuch as they carry more than half of the total livestock. A striking feature is that though these pastures have never been ploughed, the significant part of the herbage consists of introduced European plants which have in course of time colonised these areas. The pastures are generally poor and the trend is towards further deterioration. A very comprehensive programme of research, organised both on a Federal and on a State basis, is now being carried out, involving ecological mapping in association with soil surveys, manurial trials in relation to quantity of herbage and to stock rearing or milk production, biochemical studies of pasture plants, etc. The main result so far established is that the pastures as a rule respond markedly to the addition of phosphatic fertilisers, the poor type of *Agrostis* sward being replaced in time by the better grasses with clovers. The formulation of recommendations applicable to the different soils and climates will only be possible after vigorous research over many years. An ecological study of certain

pastures of eastern Canada was presented by Mr. H. J. Whyte and served to illustrate the poor quality of many of these and the need for improvement.

Certain detailed aspects of pasture research in England were described by Mr. G. E. Blackman and by Mr. Martin Jones of the Jealotts Hill Research Station of Imperial Chemical Industries, Ltd. Mr. Blackman showed that under spring conditions, nitrogenous manuring stimulates growth within a certain temperature range only. During midseason, water supply rather than nitrogen is the controlling factor. The effect of light on the growth of pasture plants is complex, varying with the species, with the available nitrogen supply and even with the form in which the latter is added.

Mr. Martin Jones dealt with the competition to which the constituents of grassland are subjected by neighbouring plants and showed how differences in habit or rate of growth lead to the dominance of certain forms or the suppression of others. Grazing by animals is of the greatest importance in this connexion, the effects on the development of any particular constituent varying according to the intensity of grazing at any given period. The correct management of grazing is therefore essential for the maintenance of any particular type of pasture.

TROPICAL FORESTS

In a session devoted to "Succession of Tropical Forest Types" Dr. Burtt Davy dealt with the evolution of tropical African forest types and pointed to the presence of a considerable percentage of Indo-Malayan forms in West Africa though they are no longer to be found in East Africa. He attributed this peculiar distribution to elevation of the land surface, subsequent to migration, with resulting lowering of temperature and desiccation of considerable areas of low country. It was therefore suggested that low-level, broad-leaf tropical rain-forest was at one time more widespread in East Africa than it is now. The presence of a small but significant palæoarctic element extending from Abyssinia as far south as temperate South Africa indicates relatively modern immigration along the temperate zone corridor formed by the high eastern mountain chain.

The distribution of forest types in Nyasaland was briefly described by Mr. P. Topham. The range of elevation within the region extends from 200 ft. to 10,000 ft. and at least nine groups of forest types are to be noted. The biotic factors of greatest importance in relation to distribution are local history, bush fires, cultural methods, fallow periods, grazing and soil rejuvenation by termites. In the absence of long-term fire protection experiments and of fuller local records, the ecological succession of the different types is largely speculative.

The distribution of various Nigerian forest types in relation to temperature, rainfall and elevation was described by Mr. W. D. MacGregor, and particular stress was laid on the succession from the open park-land to the moist deciduous type of forest. Experiments have shown that over considerable areas such a succession takes place with fair rapidity provided there is a nucleus of deciduous forest sufficiently near to supply an abundance of wind-borne seed and provided the area is protected from farming and, in its earlier phases, from grass fires. The importance of enlarging the area of deciduous forest as a check to advancing desiccation from the Sahara was emphasised.

Mr. P. Richards gave a comparative account of three areas of tropical rain forest situated in British Guiana, Sarawak and Nigeria respectively. Each area was studied intensively rather than extensively, and the data were collected so far as possible in a quantitative form. The structure was studied by means of profile diagrams based on measurements of all the trees on clear-felled plots, and the floristic composition was at the same time determined. The structure is fairly similar in all three localities. An interesting point is the close analogy of the forests on white sand in Sarawak and British Guiana, suggesting that there may be parallel edaphic variations from the climax in different regions of the tropics.

An ecological investigation of peculiar interest was described by Mr. C. G. Trapnell in relation to the application of ecological methods to the study of native agriculture in Northern Rhodesia. Various native tribes have discovered—some more exactly than others—the association of certain wild plants with soils of a certain type and are able to fix on the location and decide on the nature of their cultivated crops in accordance with such observations. Efforts to advance the prosperity of the country should be directed towards building on the foundations already laid by the native himself, rather than to hazardous introductions or innovations.

FRUIT STORAGE

The enormous amount of research, much of it emanating from Empire sources, which has in recent years been directed to problems of fruit storage and transport, made it peculiarly suitable that a session of the Conference should be devoted to that subject. The fact that, as one speaker pointed out, imports of Empire fruit into the British market have increased six-fold in the last twenty-five years and now constitute nearly half of the total import shows how research and the practical application of it are proceeding hand in hand with the advancement of Imperial trade.

Of the eight papers presented, five came from overseas contributors and the remainder from workers of the Food Investigation Board. The problems involved are of extraordinary complexity, involving as they do not merely the factors which immediately affect storage of fruit—for example, temperature and humidity of the store, mode of packing, state of maturity of fruit when put in the store, etc.—but a multitude of others which come into play while the fruit is still on the tree. Such are the effects of soil, of climate, of rootstock and so forth on the keeping quality of the fruit. The problems are in the main similar whatever the fruit or the country of origin, though the relative importance of the different factors may vary from one problem to another. For these reasons no summary which would even indicate details will be attempted here.

Dr. C. Wardlaw and Mr. R. Leonard discussed the problems of the storage of tropical fruit. Investigations at the Imperial College of Tropical Agriculture range from empirical testing of the storage behaviour of various tropical fruits—banana, lime, grape fruit, avocado pear, etc.—to fundamental studies of the gaseous exchange occurring during growth and ripening. Canadian researches, summarised by Dr. H. T. Gussow, covered the whole field of the storage of apples. Mr. H. Turner of the New Zealand Fruit Board dealt chiefly with systems of refrigeration and

methods of stacking fruit in the holds of ships. Mr. N. E. Holmes, in connexion with the transport of Australian citrus fruit, discussed fungal spoilage and loss of flavour in relation to age of the fruit, and the value of various methods as tests of the state of maturity, while Mr. D. J. Dreyer described experiments relating to mechanical damage to South African pears. With reference to the gas storage method, which has been rapidly taken up by some English growers of apples in the last few years, Dr. C. West advised a certain amount of caution, as much research work still remains to be done before the method is placed on a sound basis. Finally, papers of a fundamental nature were read by Dr. A. S. Horne and by Mr. R. Gane, the former discussing the results of a quantitative study of the resistance of apples to fungal invasion and the latter dealing with some interesting effects of ethylene gas on the respiration and maturing of banana fruit.

In the final session, Prof. E. E. Cheesman directed attention to the pressing need for greater facilities within the Empire for the collection and classification of crop varieties and related species. The menace of Panama disease and of witch-broom disease to banana and cacao cultivation respectively makes it imperative that wholehearted attempts should be made to discover or to breed suitable varieties of the crop plants resistant to these diseases. The work is seriously handicapped at the moment by the lack of adequate facilities.

An interesting feature of the Conference was a series of exhibits comprising, in addition to the illustrations of South African plants already mentioned, a collection of types of cultivated *Sorghum* and of cowpea (*Vigna* sp.) prepared by the staff of the Royal Botanic Gardens, Kew, and an exhibit illustrating Linnæus's development as a botanist arranged by the Librarian of the Linnean Society.

Conference of Empire Meteorologists

TWENTY-FIVE Dominions and Colonies were represented at the third Conference of Empire Meteorologists which was in session at the Meteorological Office, South Kensington, on August 12–21. Six years have elapsed since the previous conference and there have been important changes during that period, both in the organisation of colonial meteorological services and in the demands made upon them for data, either for home consumption or for international dissemination. There were two main reasons for calling the conference, first to give the directors of services an opportunity of discussing their problems before proceeding to the International Conference of Directors to be held at Warsaw this month; secondly, to discuss the meteorological arrangements necessary to meet the Government's requirements in connexion with the Empire air-mail scheme.

At the same time, the meetings provided an opportunity for the exchange of views on many other questions of a general character. In meteorology, problems of co-ordination are not less important than purely technical problems. It is, therefore, very necessary that the administrators of meteorological services should meet from time to time to discuss these matters. Within the Empire we have a wide diversity, not only in climate but also in the administrative arrangements for handling meteorological data. A meeting of Empire meteorologists thus provides a means for considering problems from every angle, and has a special value for that reason.

At the opening meeting on August 12, the delegates were welcomed by Sir Henry Lyons, vice-chairman of the Meteorological Committee. Mr. J. Patterson, director of the Canadian Meteorological Service, was elected president of the Conference. At the first business meeting, the Government's policy in regard to the Empire air-mail scheme was outlined. This scheme involves both day and night flying, and adequate meteorological services must be a fundamental part of the necessary ground organisation. Linked up with the question of organisation are such technical matters as the making of synoptic charts on a uniform plan, the coding of reports from land stations and ships and the choice of hours of observation. Air-mail pilots are familiar nowadays with synoptic charts, and it is important that they should be able to consult up-to-date charts at their ports of call. It is also important that a symbol they see on a chart in one country should have the same meaning as a similar symbol on a chart they see in another country. The delegates will have to consider the international aspect of this matter of symbols at Warsaw, and the discussion in London proved very useful.

Questions connected with aviation and with synoptic meteorology occupied the first few meetings. These were followed by discussions on meteorology for the Army and for the Navy, instruments, upper-air observations, marine meteorology, geophysics, climatology and agriculture, and seasonal forecasting. The use of upper-air data has assumed increased importance with the advent of air-mass analysis for the purpose of synoptic diagnosis. In many colonies there are special difficulties, however, in the way of obtaining the data. One difficulty is that of procuring hydrogen for the inflation of pilot balloons, and it was of interest to learn how the difficulty is being met in Canada by the use of a portable electrolytic generator, and in East Africa by an ingenious chemical generator, the essential part of which has been adapted from a commercial pressure-cooker.

In connexion with geophysics, the Conference passed a resolution recommending the establishment of a station at Chesterfield Inlet, Hudson's Bay, Canada. This station would be in near proximity to the North Magnetic Pole and its situation would also be very favourable for auroral studies. The conference also recommended the establishment of a station at Tristan da Cunha, observations from which, situated as it is about midway between the Cape of Good Hope and South America, would be of great value.

The discussions on climatology and agriculture began on August 19. Perhaps the most interesting subject in these categories was that of the broadcasting of climatological data. Students of world climatology have previously been handicapped

seriously by the difficulty of obtaining current climatological data. The monthly summaries issued by the various services are often published many months in arrear, and it has thus been impossible to put together an up-to-date picture of the climatological conditions all over the land areas of the globe. Lieut.-Colonel E. Gold gave an outline of a scheme for the broadcasting of brief data from selected stations in each country on the fifteenth of the month following that to which the data refer. This scheme will come before the international conference at Warsaw; its successful realisation would be an advantage not only to climatologists but also to business men who require recent information in regard to the general weather conditions in distant lands.

The subject of seasonal forecasting gave rise to an interesting discussion. Everyone of course recognises the great advantages that would ensue if some reliable method could be evolved for forecasting the general character of the weather some weeks or months in advance. The existing methods were brought under review, but it can scarcely be claimed that we are within sight of a solution. An elaborate preliminary study of the main causes of variation may, as in the case of the monsoon rainfall of India, result in the derivation of an equation from which a forecast can be made with a certain degree of success. The general view, however, was that none of the methods hitherto explored had given results good enough to justify the inauguration of an official service of long-range forecasts. E. G. B.

Educational Topics and Events

GLASGOW.—The King has been pleased, on the recommendation of the Secretary of State for Scotland, to approve the appointment of Mr. Duncan MacCallum Blair, professor of anatomy and Dean of the Medical Faculty, King's College, University of London, to be regius professor of anatomy in succession to Prof. T. H. Bryce, whose resignation takes effect on September 30.

COLLEGE library administration carried to a high pitch of activity is exemplified in Columbia, Missouri, where librarians, spurning the role of mere custodians of books, make it their business to become acquainted with and contribute to class-room instruction and make systematic provision for acquainting lecturers with the library's resources with reference to current work. They visit classes, participate in faculty meetings, hold instructional conferences with students and conduct introductory orientation classes. Collections of books are disposed where they are most easily accessible to students both in common-rooms, in class-rooms, in laboratories and in hostels. Conversely, the instructional staff, besides encouraging students to make the most of the library's resources, act as assistant librarians and give regular instruction in the technique of reading, especially the timed reading exercise followed by a comprehension test. In fact, reading is recognised as the student's chief tool, and the college holds itself responsible for seeing that every student becomes highly skilled in the use of it. The head librarian is at the same time dean of instruction and his aim is to make the library the "heart of the college". The above facts are gleaned from correspondence in *School and Society* of May 18.

Science News a Century Ago

Consumption in Man and Animals

IN a long review of "A Treatise on Pulmonary Consumption" by Dr. James Clark, M.D., F.R.S., the *Athenaeum* of September 5, 1835, said: "The Chapter on the Statistical History of Consumption contains many curious facts, and is accompanied by several valuable tables affording much matter of interesting reflection to the political philosopher. It appears that more than one-fourth of those who die from birth to puberty are affected with tuberculous disease; that the greatest number of deaths from consumption occur between the age of twenty and thirty . . . the mortality being probably at its maximum at thirty and gradually diminishing from that age. . . . The chapter on the disease in animals affords much interesting information. . . . In the gardens of the Zoological Society in Regent's Park Mr. Owen has found the disease in the tiger, the Persian lynx, the paradoxure gennet, the civet cat, the Indian ichneumon, the brown coati mondi, the Nepâl bear of the Himalayas, the American tapir, the American elk, in various monkeys, in the Eskimaux dog and in the lungs of the Python tigris".

The Zoological Society

AT a meeting of the Zoological Society held on September 8, 1835, Thomas Bell being in the chair, "a marmazet was presented from Mr. Moore of Rio Janeiro, the first that has ever been seen alive in this country. This, the most diminutive species of the monkey tribe, is about the size of a small rat, and even when full grown can be put into a half-pint tumbler. The greatest singularity is its large bushy tail, in which it completely envelopes itself when it retires to repose, to screen itself from the cold. The countenance of this species is that of an old man; and the one presented to the Zoological Society is said to bear an exact resemblance to that of a celebrated French diplomatist". (*The Times*, September 14, 1835.)

Capt. Back's return from the Arctic

ON September 10, 1835, *The Times* announced the arrival in Liverpool of Capt. George Back on his return from his journey in search of Capt. John Ross, and the following day quoted the following passages regarding Back's expedition from the Montreal papers: "During the first winter the expedition had to endure great privations, owing to the scarcity of food and the severity of the weather. Captain Back is the first European who has visited the Great Fish River and examined its course to the Polar Seas. Its very existence was doubted by many geographers. It is said to be large, but dangerous navigation; greatly impeded by ice; it falls into the Polar Sea. Further than this, we only know that the party of intrepid travellers had to encounter every obstacle to which Polar navigation is liable, and we are led to believe that immense masses of ice, with severe weather finally arrested their progress. Captain Back will, we believe, have much interesting information to communicate respecting his observations on the Aurora, the changes on the needle as he drew northward, etc. The extreme cold he experienced, we learn, was 70 degrees below zero. The expedition returned to Fort Reliance which Captain

Back left on the 20th March 1835, and travelled on snow-shoes to Chippewayan; from this station he departed on the 28th of May and arrived at Lachine on the 6th of August." Back, who was born in 1796, was knighted in 1839, and was made an admiral in 1857. He died on June 23, 1878.

Progress of the London and Greenwich Railway

THE *Mechanics' Magazine* of September 12, 1835, said: "The London and Greenwich Railway viaduct is now fast approaching completion, and presents a very imposing appearance. It forms a highly interesting object from the summit of Nunhead Hill, at the back of Peckham, from which the whole range of arches, seen in nearly its entire length, appears like the 'counterfeit presentment' of a Roman aqueduct. Nunhead Hill is decidedly the best point from which to obtain a general view of this magnificent work, which there forms a part of the foreground to an exquisite and comprehensive panorama of the metropolis, in its whole enormous length from Chelsea to Greenwich, with all its 'domes and spires and pinnacles', amongst which those of Westminster Abbey and St. Paul's are of course the most conspicuous."

Societies and Academies

PARIS

Academy of Sciences, July 16 (*C.R.*, 201, 181–244). JEAN LOUIS DESTOUCHES: Definition of the stability of propositions. ROBERT FORTET: Probabilities '*en chaîne*'. ANTOINE APPERT: Normal measures in separated spaces. A. RAUCH: The extension of a theorem of Lindelöf and Phragmén. DAVID BELORIZKY: The nebular spectrum of Nova Herculis. MATÉI MARINESCO: The use of low-frequency reaction in triode valves. GEORGES VAUDET and RENÉ SERVANT: The spectra of exploded wires in the extreme ultra-violet and the Schumann region. A fine wire, exploded by an electric current, forms a very intense light source, as although the time of exposure was of the order of 20 microseconds, good photographs were obtained with a grating. The lines were spark lines. MICHEL DUFFIEUX: The influence of the chemical medium on the bands of the second positive group of N_2. HUA-CHIH CHENG and JEAN LECOMTE: Some remarks on the vibration frequencies of chlorine derivatives. Discussion of Raman and infra-red spectra. PAUL SOLEILLET and SERGE NIKITINE: Comparison of the polarisation of the light emitted by resonance in an atomic jet and in the non-directed vapour. ANDRÉ KLING and ARNOLD LASSIEUR: The electrical conductivity of water. The electrical conductivity of water does not appear to be constant, and the determination of small quantities of carbon dioxide in solution by measuring the electrical conductivity is impossible. GEORGES COLANGE: Research on the optimum lighting of photographs and engravings. WITOLD BRONIEWSKI and W. PIETREK: The structure of the nickel-cobalt alloys. Curves are given showing the variation of physical properties with the composition. There is no evidence of the existence of a definite compound of nickel and cobalt in these alloys. ETIENNE CANALS, PIERRE PEYROT and ROGER NOËL: The fluorescence of some pure substances. ARTHUR AKERMANN: The adsorption by active carbon of dilute organic vapours and their desorption by pure air. LÉON MOREAU, GEORGES CHAUDRON and ALBERT PORTEVIN: A new method of extracting the gases contained in metals. The metal forms the cathode in an evacuated discharge tube, connected with a Langmuir pump. The extraction is made at the ordinary temperature. Aluminium, after removing gas by the ordinary method (fusion in a vacuum) gave additional gases by the new method, sixteen times the original amount. FÉLIX FRANÇOIS: The system, antimony iodide – ammonium iodide – water. VICTOR LIVOVSCHI: On 4.7-dimethyloxindol. GEORGES DUPONT and RAYMOND DULOU: The pyrolysis of pinene. A new type of monocyclic terpenes, the pyronenes. The new hydrocarbons are characterised mainly by their Raman spectra. FRANÇOIS KRAUT: The origin of the breccias of Chassenon (Charente). These breccias are sedimentary formations, in which occur remains of pumice and scoria, probably from an ancient volcano nearby, in addition to debris of the crystalline substratum. CONSTANTIN PIERRE NICOLESCO: Hydrological researches in the chalk of the Paris basin. AUGUSTE CHEVALIER and RAYMOND FURON: Some Tertiary and Quaternary deposits of the islands of Cape Verde. HENRI BESAIRIE and VICTOR HOURCQ: The stratigraphy of the upper Jurassic of Madagascar. A. GUILLERD and E. BEDON: An experiment with fluorescein on the losses of the Ognon, above Lure (Haute-Saone). This river disappears into permeable strata. Experiments with the dye showed that one third of the missing water emerged in the springs of La Font (Lure), and La Noireau (Magny). JAMES ALLOITEAU: The necessity of studying sections for the determination of the Polypiers of the Cretaceous. RENÉ SOUÈGES: The embryogeny of the Verbenaceæ. The development of the embryo in *Verbena officinalis*. ROBERT LÉVY and RENÉ AUDUBERT: The emission of radiation by the eggs of *Discoglossus* in the course of development. MAURICE LEMOIGNE and ROBERT DESVEAUX: The formation of hydroxylamine in cultures of *Sterigmatocystis nigra* in a medium enriched with ammonium nitrate. GASTON RAMON and ANDRÉ STAUB: Vaccination for anthrax.

LENINGRAD

Academy of Sciences (*C.R.*, 2, Nos. 5–6, 1935). M. G. KREIN: A special class of differential operators. G. V. PFEIFFER: An integrating factor of a system of symbolic equations, equivalent to a system of linear equations in Jacobians, which satisfies the generalised conditions of Hamburger. G. B. GUREVICH: Classification of trivectors of the eighth degree. P. P. LUKIN: Dependence of internal forces on the main virial of the outer forces. N. V. ADAMOV: Geometrical meaning of the stability condition given by Liapunoff. V. EFREMOVICH and M. KREINES: Topology of surfaces of second order. TH. JUDALEVICH: Optical phenomena connected with the change in size of the spherical particles of a disturbed medium. P. A. WALTHER and S. D. PONOMAREV: Investigation of hydraulic grids. N. N. GUSEV and M. B. NEUMANN: Rate of combustion of pentane mixtures. L. J. KURTZ: Kinetics of the formation of anode films on metals (1). Protective films of silver chloride and bromide on silver. N. J. DEMJANOV and N. I. PUTOCHIN: Action of nitrous acid on triptophane. V. O. LUKASHEVICH and M. A. VOROSHILOVA: Reduction of nitrogen compounds by

iron shavings. M. K. DJAKOVA, A. V. LOZOVOJ and S. I. CHERTKOVA: An investigation of the chemical composition, properties and methods of treatment of primary tars of Cheliabinsk brown coal. G. N. MASLIANSKIJ and M. S. NEMCOV: The poisoning of molybdenum-zinc catalyst. E. A. RAZBAUM and A. N. FILIPPOV: Chemical composition of lawrovite. A. E. CHODJKOV: Tertiary deposits and the boundary of glaciation in the eastern part of the Narym region, Western Siberia. P. P. LAZAREV and L. N. FORMOZOVA: Influence of illumination on some processes in plants (2). Influence of illumination on the quantity of water and of organic substances in plants. R. I. SEREBROVSKAJA and N. I. SHAPIRO: Frequency of mutations induced by X-rays in the autosomes of mature and immature germ-cells of *Drosophila melanogaster* males. S. G. LEVIT: Sex-linked genes in man (and their relation to the problem of dominance). V. N. NIKITIN: Physiology of milk secretion.

VIENNA

Academy of Sciences, June 27. MARGARETE HOFFER: Evaporation experiments in vacuum with polonium, radium D and radium E. With electrodes containing RaD, RaE and Po, the last evaporates at lower temperatures than RaE or RaD, the differences being about 250° and 300° C. respectively. With aged electrodes, the values are higher for all three elements, but the order remains the same. ELISABETH RONA and MARGARETE HOFFER: Evaporation of polonium in oxygen and nitrogen. An apparatus is described which allows of the preparation, evaporation and measurement of the polonium in a definite gas-space, without contact with the external air. The evaporation occurs at a lower temperature in nitrogen than in oxygen. MARIETTA BLAU and HERTHA WAMBACHER: Sensitiveness of desensitised photographic films in dependence on atmospheric oxygen and on the concentration of the desensitiser. The results obtained agree best with the oxidation theory of the desensitisation process. JOSEF SCHINTLMEISTER and ERNST FÖYN: Disintegrability of the elements from argon to manganese by polonium α-rays. Only potassium gave an observable, though very small, yield of H-rays, other elements giving not more than about 0·2 H-rays per 10^6 polonium α-rays. ERNST BEUTEL and ARTUR KUTZELNIGG: Behaviour of cellulose towards liquid chlorine, iodine, and iodine monochloride. ERICH TSCHERMAK-SEYSENEGG: Genetics of dimorphism and occurrence of homostyly in primulas. FRITZ LIEBEN and BELLA BAUMINGER: The system sugar – amino acid – yeast. LEONORE BRECHER: Pre-induced alterations in the light-reaction threshold for the coloration of *Dixippus morosus*, Br. et Redt. FRANZ MAUSER: Synchronous metamorphosis of transplanted fore-legs in *Dixippus morosus*, Br. et Redt. ATMA MALABOTTI: Histological investigation of the stick grasshopper with transplanted head. HANS PRZIBRAM: (1) Heat-sum and temperature quotient. Results obtained in the investigation of egg development, larval growth and chrysalis duration are given. (2) Quantum growth with vertebrates. (3) Transference of the metabolic level of temperature-modified rats to their progeny. KONSTANTIN TZONIS: Direct current narcosis in insects. JUSTUS ROSENHAGEN: The path of the Prambachkirchen meteorite. ARMIN DADIEU and WOLF ENGLER: Raman spectrum of $CDCl_3$. For ordinary chloroform, the spectrum consists of the six frequencies (intensities in brackets), 263(4), 369(4), 671(5), 765(3b), 1219(2), 3022(4). For $CDCl_3$, these become 265(4), 367(4), 657(5), 740(3b), 916(2), 2254(4). The line 2254 cm.$^{-1}$ corresponds with the C–D valency vibration, and 916 cm.$^{-1}$ also depends essentially on the C–D linking. ARMIN DADIEU and HANS KOPFER: Raman spectra of DBr and C_2H_5SD. RUDOLF LEUTNER: Velocity of hydrolysis of cyclic acetals (2).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 301–412, June 15). CHARLES H. MCBURNEY, WALTER B. BOLLEN and ROGER J. WILLIAMS: Pantothenic acid and the nodule bacteria – legume symbiosis. The stimulating effect of innoculating alfalfa and other legumes with appropriate bacteria has hitherto been explained on the theory that the bacteria fix nitrogen. Small quantities of pantothenic acid, which can be synthesised by *Rhizobium meliloti*, exert a marked stimulating effect on the growth of alfalfa. Culture experiments suggest that pantothenic acid is not the deciding factor in the nitrogen fixation process, but rather it plays an important part in the carbohydrate anabolism of the plant. FRANCIS G. BENEDICT and ERNEST G. RITZMAN: Lability of the basal metabolism of the dairy cow. Feeding experiments on five Holstein (*c.* 600 kgm.) and four Jersey (*c.* 300 kgm.) cows, ranging in age from 3 years to 15 years and extending over periods from two months to three and a half years, show a significant higher level (ranges of 10–90 per cent for individuals) during the pasture season (June) and a tendency for a minimum during March. There was also frequently a profound change in the metabolic level within a period of two months (ranges of 30–85 per cent for individuals). Rubner's concept, formulated about fifty years ago, that all resting warm-blooded animals give off heat in direct proportion to their surface areas, and at a constant rate, irrespective of species, of 1,000 cal. per sq. m. of body surface per 24 hours, now requires modification. L. D. LEET: The Provincetown, Massachusetts, earthquake of April 23, 1935, and data for investigating New England's seismicity. A very slight earthquake was felt on this date along the tip of Cape Cod. It was recorded at Harvard, Mass., with a Benioff seismograph. This instrument has been calibrated by recording dynamite blasts in quarries, and it was therefore possible to fix the focus at 117·5 km. from Harvard. More such instruments, which are capable of giving useful records of such slight local earthquakes, are required. ROBERT A. MILLIKAN and H. VICTOR NEHER: Equatorial longitude effects on cosmic rays. A progress report. Shielded and open electroscopes taken on voyages round the world show a sudden dip in causing the equatorial belt—varying from 8 to 12 per cent on different sides of the globe. A similar survey at high altitude, at present incomplete, shows an exponential rise in ionisation with height. These results indicate a dissymmetrical distribution in outer space of the earth's magnetic field with respect to a line passing through the centre of the earth. J. A. STRATTON: Spheroidal functions of the second kind. RICHARD C. TOLMAN: Thermal equilibrium in a general gravitational field. A theoretical discussion. W. W. HANSEN: On the expansion of Green's function. The discussion is confined to scalar equations of mathematical physics. FRANCIS B. SUMNER and DENIS L. FOX: Studies of carotenoid pigments in fishes. (3) The effects of ingested carotenoids upon the xanthophyll content of *Fundulus parvipinnis*. Batches of the Pacific

killifish fed on the chopped flesh and skin of the garibaldi, a brilliant orange-red fish containing much xanthophyll, showed a substantial increase in the concentration and absolute amount of xanthophyll in their tissues. Other batches fed on chopped white meat of the California 'halibut', which contains practically no xanthophyll, neither lost nor added to their stock of xanthophyll. Still other batches fed on beach worms, which are rich in carotene but have no xanthophyll, showed an increase in xanthophyll content. Hence these fish, while unable to produce xanthophyll on a diet free from carotenoids, can apparently convert carotene into xanthophyll, contrary to the prevalent belief that animals must ingest such substances directly or indirectly from plants. A. H. WRIGHT: Some rare amphibians and reptiles of the United States. F. B. SUMNER: Studies of protective colour change. (3) Experiments with fishes both as predators and prey. The predators used were blue-green sunfish, and *Gambusia* adapted to light and dark backgrounds formed the prey. The results confirmed the earlier experiments in which penguins were the predators; that is, light-adapted fish were more readily caught in a dark tank and vice versa. Fish which were immobilised by drugs were also caught more quickly. Conspicuousness, rather than availability, determines survival, and total quiescence is a definite handicap when the predators are also fish. S. BOCHNER: Summation of multiple Fourier series by spherical means. MAX ZORN: The automorphisms of Cayley's non-associative algebra. GEORG AUMANN: On a topological characterisation of compact convex point sets. MARSTON MORSE: Generalised concavity theorems. S. LEFSCHETZ: A theorem of extremals (2). J. H. C. WHITEHEAD: A certain region in Euclidian 3-space. J. VON NEUMANN: On normal operators. A. D. BERGNER and A. F. BLAKESLEE: Chromosomes ends in *Datura discolor*. CURT STERN: The effect of yellow-scute gene deficiency on somatic cells of *Drosophila*. Female cells homozygous for this deficiency are rarely viable. CLYDE E. KEELER: Headdot: an incompletely recessive white spotting character of the house mouse. G. W. BEADLE and A. H. STURTEVANT: X-Chromosome inversions and meiosis in *Drosophila melanogaster*. A general theory of the behaviour of inversions, supported by genetic evidence. HELEN DEAN KING and W. E. CASTLE: Linkage studies of the rat (*Rattus norvegicus*). Breeding tests show that, in the eleven genes which have been identified, two linkage systems occur. E. LUCILE SMITH: X-Ray and abnormalities: increased abnormality of segments in *Drosophila* due to X-raying of gametes. Irradiation of virgin females led to a number of individuals in the first generation having irregular abdomens, increase of irradiation producing larger numbers of abnormal individuals. The effect was not inherited. The suggestion that the effect is due to changes produced in the cytoplasm of the eggs seems to be confirmed by the appearance of few abnormal individuals on irradiation of males, the gametes of which carry little cytoplasm. HENRY FAIRFIELD OSBORN: The ancestral tree of the Proboscidea: discovery, evolution, migration and migration over a 50,000,000 year period. An advance account of a forthcoming monograph on the Proboscidea, with a discussion of the bearing of this work and of Prof. Osborn's corresponding work on the Titanotheres on the mechanism of the evolution of species.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, September 8

BRITISH MUSEUM (Natural History), at 3 and 4.30.—Miss M. R. J. Edwards: "Pioneers".*

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (NORWICH MEETING)

Monday, September 9

At 10 a.m.—Sir Arthur Smith Woodward: "Recent Progress in the Study of Early Man" (Presidential Address to Section H).

Prof. P. T. Herring: "The Pituitary Body and the Diencephalon" (Presidential Address to Section I).

At 12.—Mr. F. T. Brooks: "Some Aspects of Plant Pathology" (Presidential Address to Section K).

At 3 p.m.—Exhibition of Prof. J. S. Huxley's film "The Private Life of the Gannets" (in the Stuart Hall).

At 9 p.m.—Exhibition of educational films by courtesy of the British Gaumont Instructional Films.

Tuesday, September 10

At 8.15 p.m.—Dr. C. S. Myers: "The Help of Psychology in the Choice of a Career" (Evening Discourse in the Agricultural Hall Assembly Room).

INSTITUTE OF METALS, September 9–12. Annual Autumn Meeting to be held in Armstrong College, Newcastle-upon-Tyne.

September 9.—Dr. H. W. Brownsdon: "Metal Melting—Its Effect on Quality" (Fourteenth Autumn Lecture).

Official Publications Received

Great Britain and Ireland

Transactions of the Third International Congress of Soil Science, Oxford, England, 1935. Vol 1: Commission Papers. Pp. xii+428. 23*s*. net to Members of the International Society of Soil Science, 28*s*. net to non-Members. Vol. 2: Plenary Session Papers and the Presidential Address. Pp. iv+194. 11*s* net to Members, 13*s*. net to non-Members. (London: Thomas Murby & Co., Ltd.)

Sir John Cass Technical Institute. Syllabus of Classes, Session 1935–36. Pp. 114. (London: Cass Technical Institute.)

Department of Scientific and Industrial Research. Report on Certain Trials of Geo-electric Methods in S. Wales, with Special Reference to the possibility of their use in Detecting Underground Water in Mining Areas. By Prof. A. Hubert Cox, Dr. D. A. Bryn Davies and Dr. T. G. Williams. Pp. v+34+20 plates. (London: H. M. Stationery Office.) 2*s*. 6*d*. net.

Other Countries

U.S. Department of the Interior. Office of Education. Bulletin, 1934, No. 11: Courses in Occupational Information. By Maris M. Proffitt. Pp. v+47. 5 cents. Bulletin, 1934, No. 20. Graduate Study in Universities and Colleges in the United States. By Walton C. John. Pp. xiii+234. 20 cents. (Washington, D.C.: Government Printing Office.)

University of Illinois: Engineering Experiment Station. Bulletin No. 274: A Supplementary Study of the Locomotive Front End by means of Tests on a Front-End Model. By Prof. Everett G. Young. Pp. 42. 50 cents. Bulletin No. 275: Effect of Time Yield in Concrete upon Deformation Stresses in a Reinforced Concrete Arch Bridge. By Prof. Wilbur M. Wilson and Ralph W. Kluge. Pp. 32. 40 cents. Bulletin No. 276: Stress Concentration at Fillets, Holes and Keyways as found by the Plaster-Model Method. By Prof. Fred B. Seely and Thomas J. Dolan. Pp. 34. 40 cents. Bulletin No. 277: The Strength of Monolithic Concrete Walls. By Prof. Frank E. Richart and Nathan M. Newmark. Pp. 36. 40 cents. (Urbana, Ill.: University of Illinois.)

Malta. Annual Report on the Working of the Museum Department during 1934–35. Pp. xxii. (Malta: Government Printing Office.)

Catalogues

Mandelic Acid B.D.H.: for Use in the Treatment of Urinary Infections as a substitute for a Ketogenic Diet. Pp. 8. (London: The British Drug Houses, Ltd.)

Apparatus for the Examination of Soil. Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3437 SATURDAY, SEPTEMBER 14, 1935 Vol. 136

Social Science

THE question of the utilisation of science, raised in a discussion at the recent conference on academic freedom at Oxford, acquires the greater interest through both the recent meeting at Norwich of the British Association and also the way in which political affairs have directed attention to the necessity for considering how science can be used for human welfare. From whatever point of view we regard the dispute between Italy and Abyssinia, or the measures for defence against air raids now being initiated by the British Government, the question as to the misdirection of scientific knowledge cannot be evaded. Similarly, this year's programme for the meeting of the British Association has shown that in many ways the isolation of the scientific worker is breaking down and to an increasing extent he is considering the relation between his work and the society in which he finds himself.

As examples, one need only refer to the symposium on the State control of agriculture arranged by Section M (Agriculture), the discussions on the universities and business and on the future trend of scientific management in Great Britain before the Department of Industrial Co-operation (Section F—Economics), the presidential address to Section L (Educational Science) on education and freedom, part of which appears in this issue of NATURE (p. 416), the symposium on the herring problem arranged by Section D (Zoology). Discussions on the chemotherapy of malaria before Section B (Chemistry), on sugar beet problems before Section M (Agriculture), the place of psychology in the training and work of teachers before Sections J and L (Psychology and Education), the application of science to the control of road traffic before Sections G and J (Engineering and Psychology) or on the economic aspects of diet before Sections F and I (Economics and Physiology) further demonstrate over how wide a front this gathering of scientific workers considered the way in which the application of scientific knowledge can assist in the solution of social and industrial and economic problems.

Discussions of this type have for several years past been a regular feature of the meetings of the British Association, particularly discussions in which two or more sections have been associated in the joint consideration of a particular problem. The growing consciousness on the part of the scientific worker that the extent and direction of scientific work itself is influenced by the social and economic conditions under which he works, no less than the examples afforded of the disappearance of academic freedom in Europe, have quickened the interest of scientific workers in such discussions generally. Even those engaged in the most academic or theoretical investigations to-day cannot be indifferent to conditions around them, on which they depend both for the continuance of support and for freedom of investigation.

The very frailty of civilisation may demand certain limitations on the freedom of investigation possessed by the man of science, however different the purpose and form of such limitations may be as compared with the restrictions imposed in such countries as Germany and Italy. With the very continuance of civilisation itself in doubt, something in the nature of a mobilisation of scientific effort in its support becomes an urgent need. In a state of emergency the limited resources of scientific effort must be utilised where they can supply the greatest safeguard to humanity, whether in respect of supplying the knowledge and technique for the control of the forces already released by applied science, or for the development of a whole

new field of economy and technique for the distribution and enjoyment of the wider resources these forces when wisely used have made possible.

From this point of view, the right of society in a time of emergency to prescribe the directions in which scientific effort shall first be made can scarcely be challenged. Nor is there involved thereby the threat to creative thought which is involved in the prescriptions which we have witnessed of late on the Continent. We are, however, immediately confronted with a problem of co-ordination which is already suggested by such a programme as that of the British Association.

Discussions such as those we have indicated are commonly regarded as contributions to the development of social science. Granted that they represent contributions to our body of organised knowledge bearing on the problems which confront an organised society, how far do they contribute to the solution of problems as visualised by those who are seeking to attack such problems systematically by scientific methods? Can such haphazard discussions lead to the evolution of either policy or technique permitting of the solution of social problems in anything like the way in which problems of physical science are solved?

These questions and the underlying one of the evolution of sociology into a true science have recently been raised by Prof. Julian Huxley in a thoughtful article in the *Fortnightly Review*. The practice of using the term science both in the sense of an organised body of knowledge, as well as in the sense of knowledge and ideas amassed by true scientific methods, tends to much confused thought on sociology and on other subjects described by Prof. W. McDougall as social sciences. Admittedly sociology at the present time is merely a body of more or less organised knowledge, only a fraction of which has been amassed by methods which can be called scientific.

Its position in fact is very similar to that of history, and while on broad grounds Prof. Huxley may be right in objecting that history cannot be classed as a science, to push that objection too far is to be unjust to many investigators whose scientific study of historical method is yielding results of real value for the interpretation of social, political and economic situations, and may provide the basis upon which a true science may yet be built. In just the same way the transformation of sociology into a true science of society may ultimately be effected. Indeed, the scientific study of history may prove a fruitful source of accurate social knowledge.

Prof. Huxley, however, is not content merely to direct attention to the existing confusion of thought on social problems. He indicates the main requirements if social knowledge is to develop into a true science in the way that natural science began to emerge from a mere body of organised knowledge at the beginning of the seventeenth century. In the first place, he reiterates Prof. McDougall's plea for an adequate supply of workers of high standard. This is a first essential for the scientific study of social problems and at once presupposes first the provision of adequate facilities for the training of such workers and the existence of employment for such social workers when trained.

Given a supply of investigators of the requisite quality, the question of social experiments and their control at once looms large. Without experiment, social science can scarcely develop. At present the failure to isolate experiments and difficulties in securing such isolation are almost as great an obstacle to the accumulation of scientific knowledge as the prejudices which often influence the interpretation of their results. Despite the many new departures in economic and social practice which we have witnessed even in the last five years, it is almost impossible to draw sound and valid conclusions owing to the absence of control or the existence of vitiating factors.

The gradual evolution of an appropriate technique and the steady accumulation of social knowledge by scientific methods will go far to establish a definite science of society. Even then, however, such a science must differ somewhat from the physical sciences. In the main the physical sciences represent an approach to truth. In any social science it is the other aspect of science, which the physical researcher is prone to neglect, that is most significant—science as a means of control. Scientific workers must at least give a lead to the administrator and politician in such matters as a first step towards social control, and the recognition of this responsibility has already inspired a movement for integrating different branches of scientific research. One of the most valuable services rendered by the meetings of the British Association is its educational work in assisting that integration, and thus promoting a broad point of view in which the wiser direction of available scientific effort upon national and social problems becomes possible.

The Quantum Theory

The Principles of Quantum Mechanics
By P. A. M. Dirac. (The International Series of Monographs on Physics.) Second edition. Pp. xi+300. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 17*s*. 6*d*. net.

THIS is the second edition of the celebrated book that appeared five years ago, which has been perhaps the most outstanding book written on the quantum theory. The new edition has the same brilliantly distinctive style as the old. Much of the book has been rewritten, and a new chapter on electromagnetic radiation has been added at the end; but its main character is unaltered. Nevertheless, it must be confessed that on account of the lapse of time the flavour one derives from it is somewhat different.

In 1930, the great rush of discovery was only just over, and the exponents of quantum theory were still rather sharply divided into two camps, according to whether the wave-function or non-commutative algebra was regarded as the key idea of the theory. There was, of course, no contradiction involved, but tastes differed so strongly that one could really speak of rival schools. Dirac was a strong adherent of the non-commutative school, and from his book one would scarcely have gathered the predominating position in the subject that the wave-function has gained. Indeed, though, of course, he makes extensive use of such functions, he seems to regard them as a slightly discreditable confession of weakness. They constitute an admission that a perfectly abstract scheme cannot conveniently be made so that it will contain nothing but strictly observable quantities. He gives special warning against the analogy with actual waves, and the warning may be justified because the analogy is so good (at least for a single particle) that one is in danger of forgetting that it is only an analogy. On the other hand, he is much concerned with emphasising the analogy between the quantal and the classical mechanics; indeed, the development of this relationship is the spirit that animates the whole of the book.

During the last five years, the conflict of tastes has died down in the way that is usual in science, by the recognition that there was nothing to quarrel about. On the other hand, as a technical method the wave function has won all along the line. Except in one or two special subjects, no one now ever thinks of commutation rules, and even the matrix, not so long ago an almost sacred mystery, is now a perfectly natural feature of the integral calculus. There are two main exceptions to this statement. The commutation rules for angular momentum have a specially simple character, and since angular momentum governs most of the structure of atoms and molecules, the more purely dynamical methods have, in the hands of some, proved fruitful in the study of the closed system of the molecule. The second case where the dynamical methods are used has the honourable, though rather depressing, character of a 'forlorn hope'. There are some subjects which belonged to the classical scheme, but which do not fit at all readily into the quantal scheme; we are thinking in particular of electromagnetic radiation, which is discussed in the new last chapter. In such a case, the non-commutative methods make the fit distinctly less unsatisfactory, whereas the undulatory methods make the subject nearly incomprehensible. We must be thankful for the life-belt which keeps us afloat an extra half-hour, even if we drown in the end.

In the preface to the new edition, the author explains that he has made the book less abstract than before so as to appeal to a wider circle of readers, but it is not very clear what sort of readers he had in mind when he made the alterations. It was easy to see who should be the readers of the old book, for the list would include everybody who had any interest in the quantum theory, provided that he had acquired a considerable preliminary knowledge of the subject from other sources. Though the new work does not demand the same abstractness in outlook as the old, it still calls for the same amount of preliminary knowledge. For example, the first four chapters discuss 'states' and their 'representations' with no mention of what is being described or of how it is going to be done. The generalisations of these chapters will be most helpful to anyone thoroughly familiar with the technique of quanta; but they could not possibly serve as an introduction before that familiarity has been acquired, if only for the reason that no one is ready for a general idea, however well it may be presented, until he has a number of examples to attach it to. Moreover, the book calls for a knowledge of other subjects on a rather high level, and no student with any independence of character would tolerate being kept in deliberate ignorance of the main subject while he laboriously acquired all this ancillary knowledge. For example, a main idea in the book is the analogy between the quantal and the classical

'Poisson brackets'. This analogy was most valuable in Dirac's hands as a guide to the discovery of the quantum mechanics ; but once found, its utility is gone because the classical Poisson bracket is a troublesome thing and much more complicated than the quantal, so that most students will profitably desert the rather arid fields of higher classical dynamics, and will devote the time saved to more interesting matters.

One character of the work is to be highly commended, and that is the author's refusal to waste time over rigorous discussions of unimportant difficulties. We may paraphrase his way of dealing with such difficulties in the words: "Though something seems a bit wrong, it can't be really serious, and with reasonable precautions there is no danger." To the rigorist, this sort of thing may be shocking, but it is typical of the author's peculiar genius in being able to use a deeper formalism than can anyone else without allowing it to overmaster him. In the same way, he does not start the quantum theory with five axioms and eleven postulates, or whatever it may be, in the way so dear to the logician, but instead describes some of the physical phenomena which demand a modification of the classical mechanics, and builds up his theory from these. He is consequently free from the danger which lies at the root of all such logical systems, that when they fail it is not the fault of any of the postulates, but of something which was so completely taken for granted that the author never knew he had assumed it.

In this work (and in some others of the Oxford series) there is a bibliographical inconvenience, which proves a quite intolerable nuisance to the reader. There are frequent back-references in the text, which are nearly always in the form :—"In equation (31) of Chapter V it was shown that . . ." At the head of every page stands the number of the section and the title of the chapter, but not the number of the chapter. Consequently in looking up every such reference it is first necessary to turn back and find the table of contents at the beginning of the book.

We fear that in the above account there may have appeared a certain lack of enthusiasm for what is undeniably a great work. This lack is to be interpreted only differentially, in the sense that we do not consider the new edition any better than the old. In the old edition, the author succeeded so admirably in expressing his philosophy that the new was almost bound to disappoint our expectation of still better things. C. G. D.

Temperature and Living Matter

Temperature and Living Matter
By Prof. J. Bělehrádek. (Protoplasma-Monographien, Vol. 8.) Pp. x+277. (Berlin : Gebrüder Borntraeger, 1935.) 18 gold marks.

IN accordance with the general lines of this series of monographs, the author restricts himself almost entirely to cell physiology ; ecology and behaviour are not dealt with.

The first chapter is of an introductory nature, and is short. In the next three the author proceeds to an exhaustive discussion of the effect of temperature on the rate of biological processes, and its physical and mathematical interpretation. He explains the theory of the Q_{10} rule and the Arrhenius equation, and points out objections to their use as a means of manipulating experimental data. In particular, he takes exception to the use made of the Arrhenius equation by Crozier and his school. He proposes to substitute for these formulæ a simple empirical equation of the form $y=a/t^b$, where y is the time occupied by the process, t is the temperature, and a and b are constants, the latter having the meaning of a temperature coefficient. This coefficient, b, has, of course, no theoretical significance ; but the author claims that it is constant over the whole temperature range in many processes in which other coefficients are found to vary with the temperature.

The classification of biological processes into 'physical' and 'chemical' on a basis of temperature coefficients is unsound, since many physical processes have high temperature coefficients ; to make deductions as to the biochemical nature of these processes from their temperature coefficients is clearly still more rash. Bělehrádek's interpretation of the effect of temperature is as follows : Others have tacitly assumed that a chemical process is always the limiting factor in biological reactions, but there is no reason why a physical process, for example, diffusion, should not be limiting, since it can be shown that a high temperature coefficient is not incompatible with such a process , for if diffusion is limiting, it will be affected by the viscosity of the protoplasm, and the rate of the biological process will thus bear the same relation to temperature as does protoplasmic viscosity. The author then proceeds to adduce evidence in

support of his views, and although the theory has met with much criticism it is set forward very convincingly in this book.

The next three chapters deal with the effects of temperature on the chemical, morphological and physical properties of living systems. The question of viscosity is discussed at length, which is not surprising in view of its importance in relation to the author's theories.

Chapters viii and ix concern the relation of living matter to low temperatures, involving discussion of cold-hardiness, chill-coma and the causes of death by freezing. Evidence is brought forward to support the suggestion that chill-coma and the fatal effect of low temperatures (apart from freezing) are due to the increased viscosity, which practically stops all biological processes.

Chapter x, the longest in the book, is devoted to injury by heat and heat resistance, and the last chapter, an account of the stimulative effect of temperature, is necessarily short since a consideration of sense organs and behaviour is beyond the scope of the book.

The first four chapters cover ground which is of fundamental importance to all students of experimental biology. Throughout the book, the systematic arrangement of facts makes it a valuable addition to any library, even though these facts do not lend themselves to any very comprehensive generalisations. The size of the bibliography bears witness to an amount of work for which Prof. Bělehrádek deserves the gratitude of all biologists.

J. A. R.

Motor Fuels

The Principles of Motor Fuel Preparation and Application

By Prof. Alfred W. Nash and Dr. Donald A. Howes. Vol. 1. Pp. xiv+538+9 plates. Vol. 2. Pp. xiv+523. (London: Chapman and Hall, Ltd., 1934–1935.) 30*s*. net each.

THE reputation of Prof. Nash as a teacher and leader in the petroleum industry is such that any book from him is assured of a sympathetic reception. He has had the assistance of Dr. D. H. Howes, of the Anglo-Persian Oil Co., and his venture is launched with a foreword from Dr. A. E. Dunstan, in itself no mean recommendation.

It is common knowledge that one of the wonders of the world, something which is influencing the daily life and comfort of every one of us, is the modern high-speed, high-efficiency internal combustion engine. This requires fuel to drive it, and so a variety of problems have been set to the oil chemist which are by no means solved, and therefore still in the forefront of interest.

Knowledge, when it has a bearing on everyday life, travels apace, so that even the schoolboy and his sister talk glibly of anti-knock and gumming. The use of petroleum on its present scale is relatively a new thing; it is said that up to the present only two thirds of a cubic mile of oil has been used, and the rate of progress, which is amazing, is largely due to the fact that science has from the outset been so largely applied to the problems. As Prof. Nash says, a team of geologist, petroleum engineer, refinery chemist, business man, and sometimes physicist and mathematician, to which we would add men of energy and enterprise, has co-operated to discover, produce, refine and distribute petroleum and its products. As motorists, most of us expect to be able to stop by the roadside and refuel at a wayside pump almost at will, and it is not realised how great an organisation, how much technical effort is behind this most efficient service.

The work as a whole is divided into two volumes, of which the first deals with the production of the motor fuels by distillation, cracking, extraction from natural gas and hydrogenation. It also deals with the rival fuels not originating from petroleum, for example, benzole and alcohol. The problems of oil storage, insurance and distribution are also briefly touched upon. The second volume describes the subjects of analysis and specification, the 'gum' question, which is one of importance, internal combustion and Diesel engines and knock ratings. A chapter is devoted to aviation fuels.

The primary object of the refiner is to obtain from crude petroleum a fraction which distils over a range from 35° to 200° C., which is redistilled, etc., to marketable petrol: the book is not concerned with the subsequent operations to lubricating oil, fuel oil and asphaltic products.

Straight distillation only yields a proportion of petrol according to the nature of the crude, and as petrol was the most valuable product, means were sought to increase the proportion and were discovered in the process of cracking. In general, during cracking, low boiling constituents are produced by the breaking down under the influence of heat of the larger molecules present in the oil,

some hydrocarbons of even greater complexity being produced at the same time. Though simple in principle, cracking has offered many difficulties in practice: it is largely practised, and the total amount of petrol yielded by a ton of crude oil has materially increased in consequence, thus helping to conserve the world's oil resources.

At the well-head a great quantity of gas is liberated saturated with the lighter liquid hydrocarbons, though in itself it consists mainly of methane. It is customary and necessary to scrub out these liquid fractions before the natural gas can be pumped great distances, so there is available a considerable quantity of highly volatile spirit which is blended so far as possible with the ordinary distillates. There is naturally a limit to this blending process, and at the moment the large amount of butane for which there is no use remains one of the problems of the industry.

Every means is thus taken to obtain the maximum amount of motor fuel from a particular crude oil, which then is subjected to a drastic refining process so as to remove all constituents likely to be harmful to the engine of a motor-car, in particular the sulphur compounds—this subject receives full treatment by the authors.

In countries like our own, where there is no natural source of oil, other home sources of fuel naturally receive consideration. One of these is benzole, a by-product of the coking and the gas industry. The first effort to market this by William Butler of Bristol in 1903 was not very successful, and it was not until the formation of the National Benzole Association in 1919 that a satisfactory marketing organisation for this product, which is sold mixed with petrol, was attained. To-day 'National Benzole' is a well-known product, and the quantity of benzole produced in Britain is continually increasing, though it remains small compared with the total amount of motor fuel.

Considerable interest is attached to a second motor fuel, namely alcohol, which in many lands is likely to be widely used as the result of legislative enactments. The advances in fermentation technique, the use of cheap molasses as the source of sugar and the discovery of processes of dehydrating alcohol so as to make an anhydrous product miscible with petrol in all proportions, have done much to make alcohol practicable as a motor fuel and competitive so long as petrol bears its present high rate of duty. Methods have been worked out for making alcohol from ethylene gas, and where this is available in quantity the process is also a commercial one. If the supply of petrol failed or the product became very costly, there is no doubt alcohol could largely take its place. A lengthy chapter is devoted to the intricacies of this question: it handles also the production of methanol from water gas and the use of this alcohol as a fuel.

The production of oil from coal, either by low-temperature carbonisation or hydrogenation, is as yet in its infancy, though there is a certainty that progress will be made in both directions during the next decade. Such oils are to be regarded as home-produced crudes of special character, and they will come into the hands of the refiner for treatment. In comparison with the processes discussed, the crude oil obtained by distilling shale is barely competitive, and in normal times cannot be regarded as a serious source.

Prof. Nash has given us a scholarly and informative work which should have wide patronage. He makes clear the advanced state of the industry as regards scientific knowledge and the amount of research and development which is taking place. It is satisfactory that there are in Great Britain schools of petroleum technology of university rank and high standing. It is desirable, however, that the practice of refining be also encouraged by every possible means, lest from lack of practical operation we lose contact with what perhaps are the most forceful developments of the day in chemical engineering technology. E. F. A.

The New America: the New World
By H. G. Wells. Pp. 96. (London: The Cresset Press, Ltd., 1935.) 2*s*. 6*d*. net.

STRESSING the general problems rather than details, Mr. Wells in a series of four short but brilliantly written chapters emphasises the necessity for the deliberate readjustment of the social mechanism, so as to realise the possibilities of human expansion that are now running to waste and disaster. He holds that, if an effort is to be made at all to find a way out from catastrophe to a new lease of life for civilisation, the main part of it should come from America, as no other country has the necessary freedom of speech and mind left and all other communities are confused by the war threat.

During his recent visit to America, two aspects of that country's effort to adapt itself to the new conditions seemed to Mr. Wells unique. The first is that the struggle to reconstruct in America goes on in an atmosphere of unbridled public discussion, whereas in Britain it is restrained by habit and custom and by the centralisation of the Press in London. The second is the relative unimportance of large mass antagonisms. There is no widespread conception of a class-war ruling the situation as in Russia, or of racial incompatibility as in Germany or any such exacerbation of xenophobia as in Italy or Japan. There are conflicts of regional interests, indeed, but little regional bitterness.

Practical Applications of the Punched Card Method in Colleges and Universities

Edited by G. W. Baehne. Pp. xxiii+442. (New York: Columbia University Press; London: Oxford University Press, 1935.) 22*s*. 6*d*. net.

THE use of tabulating machines of the Hollerith electric or other types for statistical and recording work of all kinds has increased to a remarkable extent during the past fifty years. It is not, however, generally appreciated how valuable these devices have proved themselves not only in large-scale and intricate accountancy systems but also in actual statistical research in the wide and varied field of social science. The present work describes their use mainly in colleges and universities, for example, in the registrar's and business office and miscellaneous administrative applications, and in psychological, educational, medical, hospital, legal and agricultural research. In their present wonderfully improved form, the Hollerith machines work automatically with such speed and unerring accuracy in complicated statistical manipulations that, to the uninitiated, they seem like uncanny 'robots' of superhuman efficiency.

The experience of the large number of American universities and other institutions here recorded shows that both in the ordinary business routine of a registrar's office and in social research of every kind, such mechanical devices are proving to be increasingly necessary, as essential indeed as mathematics, and are, as the editor rightly insists, the natural outgrowth of the statistical method of approach to modern learning. One writer in the authoritative series of papers here presented from many fields of university and institutional activity expresses the view that, with the statistical approach so perfected by these means, a precision and dependability of research in the social sciences will be secured second only to that of the physical sciences. So far from mechanising thought, the vast reduction in time spent on laborious routine will increase the time available for clear and original thinking and accurate observation.

The Aliphatic Free Radicals

By F. O. Rice and K. K. Rice. Pp. 204. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1935.) 21*s*. net.

THE capture of particles elusive and ephemeral by Paneth and Hofeditz has proved a turning point in the century-old controversy around the question "Do free radicals exist?" In justice to recent developments, the Faraday Society's discussion in September 1933 centred chiefly round entities falling within the definition: "Free radicals are complexes of abnormal valency, which possess additive properties, but do not carry an electrical charge and are not free ions". The book under review is concerned with such radicals, of which "the most striking property is their short life".

The detection and incidental synthetic uses of free methyl, methylene and ethyl are lucidly described, and a hypothesis of thermal decomposition of organic vapours, consistent with many of the data, is based on the intermediate formation of free radicals. The authors are bold enough to prophesy in detail the courses of numerous reactions not yet investigated. Cognate reactions in the liquid phase are briefly discussed, and the hypothesis is extended, with some success, to the decomposition of large non-volatile organic molecules of the recurring-unit type. There are a few slips, such as the description of methyl and ethyl nitrites as "the methyl and ethyl esters of the alkyl nitrites" (p. 138).

Readers interested in the mechanism of reactions will, however, find this a useful, well-produced book with a comprehensive up-to-date bibliography limited by the scope of the title, but the price seems rather high to command a ready sale to individuals.

The Hardness of Metals and its Measurement

By Dr. Hugh O'Neill. Pp. xiv+292+24 plates. (London: Chapman and Hall, Ltd., 1934.) 25*s*. net.

ALTHOUGH the hardness of a substance is not a physical constant, and cannot be expressed as a function of known physical constants, the idea of hardness is a familiar one, and empirical determinations of hardness play a great part in the study of materials. Methods depending on scratching now take only a subordinate place, and 'resistance to indentation' is the most generally accepted definition of hardness. The Brinell test, in which a hard ball is pressed into the object under a known load, forms the basis of most hardness testing, but the introduction of the diamond pyramid, as in the Vickers test, in place of a steel ball, has given greater precision to the test.

The author of this useful manual has made a special study of hardness, and is known as an investigator of the subject. Besides a clear account of the methods of determining hardness in the laboratory and in the workshop, the book deals fully with the influence of the time factor in deformation and with the relation of Brinell hardness to such mechanical properties as tensile strength and capacity for work hardening. The author emphasises the value of 'Meyer analysis' in the investigation of the latter property. Such subjects as resistance to abrasion and the cutting quality of tools and cutlery are also discussed. The manual will be found of the greatest value as a work of reference. C. H. D.

Esquisse du progrès de la pensée mathématique: Des primitifs au ixe Congrès international des Mathématiciens.

Par J. Pelseneer. (Bibliothèque scientifique belge.) Pp. 161. (Paris: Hermann et Cie, 1935.) 15 francs.

IT is not the technical results of mathematical progress, but rather the development in the outlook of mathematicians, which is very ably sketched in this little book. From the primitive attempts of reckoning to the dizzy heights of contemporary mathematics, we thus have before us an ordered and most suggestive exposition of the mathematical atmospheres of the ages. Selected quotations from the leading mathematicians help us to understand the progressive changes in their interests and methods. This is an interesting contribution to the history of science. T. G.

Education and Freedom*

By Dr. A. W. Pickard-Cambridge

NO one with any power of discernment can have failed to note two opposite tendencies at work in the present day: one, a tendency antagonistic, both in intention and in fact, to freedom; the other, a tendency to lay claim to freedom in ways which it is not always possible to defend. The second of these tendencies is seen in a number of educational theories which would, so far as possible, exclude discipline from life in the supposed interests of free development; and also in a certain impatience with all forms of authority, of which those who are associated with young people have been more conscious in recent years than, for example, before the War. But the other tendency we can see writ large on the recent history and present condition of nations and also reflected in the smaller letters of individual mentalities. In Germany, Italy and Russia we are watching the complete subordination of the individual to the State, not only in his external life and action, but also, so far as education and propaganda can achieve it, in thought and will.

If such phenomena were only presented to us by foreign peoples, they would even then merit our very serious attention; but he would be very blind who did not see the same tendency at work among ourselves. We call ourselves a democracy, and the essence of democracy is that it rests upon the free expression of individual thought; but the rigidity of organisation in our political parties has increased during the present century to an ominous degree, and with it the application of what is called 'party discipline', depriving the individual of all freedom of action and speech, whatever freedom of thought he may privately retain. It is at least equally serious, that some of the constructors of the imaginary Utopias which have been most popular with the younger generation in the last few years clearly envisage and apparently approve of political and educational systems based upon the complete elimination of individuality.

Now if this view is accepted, if it is definitely decided that freedom is not worth keeping, the consequences in the field of education will obviously be accepted also—the strict control of all that is to be taught, and of the method of teaching it; the exercise of thorough-going espionage upon teachers and pupils, and the encouragement in both ranks of the giving of information against colleagues and companions; the supervision of every part of the individual life, so that there may be no loophole anywhere for the intrusion of counter-influences, and no opportunity for the expression of free thought. There may be those who feel that such a state is what ought to be; and I do not now propose to argue with them; but what I have to say is based upon the opposite assumption, that individual freedom, subject to such a minimum of restriction and organisation as is necessary for life as a member of a community, is the indispensable condition of a good and even a tolerable human existence, and that just as the educational systems of coercive States, real or imaginary, are directed to the maintenance of the systems of government and life which have given rise to them, so the educational system of a democratic State, which is based on the principle of freedom, should be directed towards the maintenance of that freedom, and the encouragement of its responsible use. As the principle of the direction of education in accordance with the 'spirit of the State' must necessarily result, in the authoritarian State, in training citizens *not* to think, so education in the spirit of a polity of free men and women must above all train them to think freely and accurately, and to desire to carry the results of their thinking into action. As the former type of State will try to produce a standardised and unresisting mentality, the latter will allow the utmost variety and will look for the good life of the community to the clash in rational discussion of the most diverse views, brought to judgment before the bar of a public opinion in the formation of which all alike may take their part.

The ideal State and community will be a democracy in which every individual is free to realise the highest values, physical, moral and spiritual; and the realisation of some of these is only possible if he can enter into freely determined mutual relations with others, participating fully in the life of the community, communicating his share of good to it, receiving his share of good from it. The community and the State will recognise fully the value of the individual personality, and will acquiesce in no condition which makes any individual merely a means to the well-being of others, or to the stability of the organised

* From the presidential address to Section L (Educational Science) of the British Association delivered at Norwich on September 6

community, for the sake of which in authoritarian States, real or Utopian, individuality is sternly suppressed.

But the desired freedom of the individual has to encounter obstacles of more than one kind, and it is in a great measure with these that education has to deal. The obstacles are partly in himself, partly in the community. It is obvious at once that no one, as he is, is completely free. Everyone is greatly hampered by the effects of heredity, which, whatever the mechanism, seem to be mental as well as physical; by the influence of body upon mind; by the tendencies imparted by early environment and habituation; and by the results of his own actions. Yet it is probably a fair summary of what may be inferred from common experience, that each individual has at any moment a certain balance or reserve of freedom, that is, of power to act in the way which he recognises to be good—a balance or reserve which he can increase or diminish by every individual act, every exercise of will, so far as he *is* free. Therein lies (as all moralists have seen) the importance of each single action; for it is in the determination of single actions that increased freedom must be won. By constant action in one direction, habits are formed which it is very difficult to break. By repeated choice of the higher as against the lower values, the choice of these becomes easier; freedom is increased. Accordingly, one purpose at least of education is to set what seem to be the higher values before the immature mind in such forms as it can understand, and to encourage the habit of choosing them. About most of these higher values there is really very little doubt, and in such forms as kindness, unselfishness, truthfulness, fair-play, thoroughness, neatness and other elementary kinds of beauty, they are as accessible to young minds as to old.

Further, the importance of discipline depends upon the fact that without it—without a certain external compulsion at times—the immature personality may not discover that it *has* the freedom to choose something other (and, as it will afterwards recognise, something better) than that which immediately appeals to it. Discipline, correction and guidance reveal the power of choice—of doing what you do not want to do; and in time self-discipline follows and freedom increases in proportion—freedom, that is, to pursue and realise ends or values deliberately chosen, because they are recognised as good. No one can possibly be less free than one who has always been allowed to do what he likes; he will never have discovered that he can do anything else. To deprive the young in the name, forsooth, of freedom, of all benefit from the experience of earlier generations—to put *no* values before them as good—is not, in fact, to increase, but to restrict their freedom by denying them the conditions of a fair choice. The young mind has neither the information nor the training to decide everything for itself. But it *is* the object of education and of discipline that it may ultimately have these, and may do some things, no longer because they are imposed by authority, but because they are recognised to be good, and other things, it may be, because the ideas suggested by authority have now been revised and modified by the growing reason. If the discipline and guidance are accompanied, so soon and so far as is possible, by reasons which will not only suggest why it is that such and such acts and habits are good and so cause the discipline to be willingly accepted, but will, above all, help to form the habit of reasoning and of considering what *is* good or bad, the result, so far from hampering freedom, will be to elicit and enhance it.

It is clear that over and above the influence of wise suggestion and example, not only in the general life of the school as a society, but also in the choice of literature, in the study of characters both in literature and history, and in the presentation, in however simple a form, of the working in history of cause and effect, an immense opportunity is open to the teacher.

But education has much more to do in the cause of freedom than the encouragement of a habit of discriminating between good and evil, or better and worse, and the suggestion of the lines of such discrimination. For before life is far advanced, the simple problems and issues of early days are merged in far more complicated issues, requiring the utmost clarity of thinking; and not only does the true discrimination between values itself become more difficult, but also a knowledge of facts, a power of analysing them and appreciating their bearing, and therewith an understanding of the particular conditions in which the realisation of ideals of good has to be attempted, become essential; in short, a clearness of perception and judgment without which the best intentions may end in disaster.

For effective thinking two conditions are necessary: first, that the materials with which thought has to deal shall be so far as possible true, or, in other words, that truth about facts shall be accessible; secondly, that the mind itself shall have been trained to work accurately and honestly; and if freedom in political and private life is to be preserved, those who educate others must put them in the way of obtaining truth about facts and of distinguishing truth from falsehood in what is presented to them and in their own reasoning. It would take a very brave man to deny the immensity of the obstacles. Even in a country so free as our own, the temptations to accept opinion

manufactured by others, not always for the best ends, are enormous.

Yet preparatory work may be done on the lines which are followed, at least in a few schools, in which in some upper forms present-day problems are discussed, or the news of the week presented, in ways which encourage older boys and girls at least to think about them, to be aware of the two or more sides that each question presents, to realise the duty which lies upon them, or will shortly lie upon them as citizens, to get the best information and to form their opinion with a high sense of responsibility and a disregard of the interest of class or self. They can be led to realise that democracy is less a system of equal rights than a system of equal responsibilities; and even the common life of the school can teach them how much one clear and decided mind can do in shaping the opinion of its own circle. The foundation of habits of impartial and critical judgment *can* be laid at school, and if they are not laid there, the odds are heavily against their being laid anywhere else. The teaching of history is an obvious instance of the opportunity which education affords for the formation of habits of careful judgment. As in all other matters, there must be an impartial presentation of facts and issues, and, if possible, opportunity of discussion of a kind suited to the age of the pupils.

In other ways, the dangers of dependent, unventuresome and even servile mentality may be partly met by the school. Young people are much more likely to *think* for themselves, if, subject to the necessary framework of school discipline which is scarcely felt so long as it is wisely controlled, they *do things* for themselves. This is well understood in the older public schools, but I confess that in a great number of secondary schools—and secondary schools are of special importance, because from them should come the leaders of opinion in nearly all those smaller circles in which, much more than on platforms, public opinion is made, as well as most of the future teachers of the mass of the people—I should like to see a good deal more room for independence and self-government. It is impossible to train young people in the free use of judgment without letting them exercise it freely in their own affairs and (with slight and obvious limitations) make their own mistakes, and grow in the power of judging how to act and of understanding the characters one of another; for in a free State, the power to choose persons is as important as the power to choose between policies, and there is no place so good as a school for learning either to lead or to choose and follow a leader.

Again, no one can deny the effect of the mechanised drama, which is the almost universal recreation on certain days in the week, in producing a standard mentality (one might almost say a uniformity of bad taste) and in confining interest to monotonously narrow lines; and the fact that the interest in sport of which our countrymen boast takes, for nine-tenths of them, the form not of healthy personal activity but of massed attendance at the performances, provided for them by no effort of their own, of two teams of hired entertainers or of a few trained dogs, is not indicative or productive of an active intelligence. If education is to counter this, it must encourage those occupations of leisure in which the individual can exercise his own free choice and express himself—the performance (not merely the hearing) of music and drama, the practice of handicrafts, of arts, of gardening, of all kinds of performances which are personal, not mechanical. It must set before the young the infinitely various ways of spending time worthily; and must encourage an attitude towards books and reading which few of our examination-ridden youth attain. For all these things are the activities of free minds, not of those which accept unthinkingly everything which is superficially attractive and is therefore accepted by crowds. Without some such influence from education, we can expect only passive minds, barren of ideas, and unable to rise by freedom of thinking to meet the perpetually changing needs of the world in which they are called upon to live.

As I have spoken of examinations, I had better say explicitly that I rank examinations, not in themselves, but as they are treated in most schools at the present time, among the worst enemies to education in freedom of thought and independence of judgment. Examinations can be, and should be, invaluable aids to education; but it is a condition of this that they should be only an incident in the work of the school, testing at convenient points the work of both teachers and pupils, and really, and not merely by profession, following and not directing the curriculum. Their usefulness is undoubted in training the young mind to do what it will continually have to do afterwards—namely, to bring whatever knowledge and resource it may have to bear on a particular point at a given moment, and in this both intellectual and moral qualities are involved. But where the whole work of the school is planned to cover or lead up to the syllabus of some particular examination; where every subject is studied at a rush in order to work into the pupils' minds what are virtually prescribed answers to questions which may almost be said to be prescribed, so narrow is the range from which they can be drawn; where the teacher does not dare to encourage his pupils to think; where he cannot go at his own pace and cover in his own way the ground which he can effectively cover, for

fear of the effect on the statistics by which the local education authority, knowing little of education, judges the efficiency of his school and his own fitness for promotion, or by which the employer, knowing even less, judges the suitability of individuals for purposes never contemplated by the examination authorities—there examinations are a very mischievous thing. Unless the habit of working and teaching for examinations before everything else is abjured, I see little hope of the type of education which alone can save democracy, and bring up a race of free men and women.

There are other reforms which are urgently needed, if our present system of education is to be brought nearer to the fulfilment of such an end. The prolonging of the time of education is obviously one, provided that the education is of the type which liberates and trains the mind, and does not merely rivet its fetters more tightly. A great reduction in the size of classes in most subjects is another; not necessarily in all subjects, or for all purposes; but such a reduction as will give the individual member of the class a chance, and will enable a teacher to encourage a pupil who has a line of his own to follow it up, and to see that every pupil is mentally active and not merely receptive. Young people have not indeed enough experience to prescribe or to conduct their own studies to the extent imagined by some enthusiasts; but they have minds which should not be allowed to be inert or be driven along precisely the same route as twenty-nine or thirty-nine other minds, and the smaller the class the less the risk of this.

The suggestions which I have made as regards educational practice have nothing new in them, but I have deliberately chosen familiar instances to illustrate my main contention. My object has been to assert that these are no matters merely of theory or of finance or of administrative or political convenience, but of vital and immediate urgency, if we are not unconsciously to bring up a race which, with its mind stunted, its capacity for freedom undeveloped, will be the easy prey of the politician, the journalist and the dictator; and that if a free democracy is to continue, we must educate for it, for in many respects our present educational system is better calculated to produce a servile and passive mentality than to elicit an activity of mind and an independence worthy of free men and women.

We have reached a point in the history of Western civilisation when the forces which make for the enslavement or the inertness of mind and spirit are active as they have not been for centuries. It is therefore incumbent upon us to test our educational institutions and methods at every point by their tendency to produce or to hinder freedom of mind, to cut out all that makes for the standardisation of individualities or is hostile to ultimate independence of judgment, at the same time so setting before the young the higher values, which make for good life and good citizenship, that they may have the chance of freely making them their own. If we can do this, we may yet see the development of a type of humanity richer in freedom, self-discipline, courage and vision than any which the world has yet known.

Recent Progress in the Study of Early Man*

By Sir Arthur Smith Woodward, F.R.S.

WHEN meeting in East Anglia it is appropriate that the Section of Anthropology should devote special attention to prehistoric archæology. In this part of England so long ago as 1797, John Frere made the first scientific observations on palæolithic implements which he had dug out of a superficial deposit at Hoxne. During recent years, Mr. J. Reid Moir has excited wide interest by his discoveries of the oldest known stone implements, which he has collected with remarkable zeal and discussed with acute observation. Here also arose the 'Prehistoric Society of East Anglia', which has been so well supported during its career of more than twenty years, that it has gradually widened its sphere until now it becomes the 'Prehistoric Society', devoted to advances in its subject in all parts of the world. We are, indeed, now confronted with problems much greater than those which the pioneers in western Europe dealt with, when they were laying the foundations of research in prehistory. Traces of men who lived before the dawn of history in widely separated parts of the earth's surface have been discovered in increasing abundance during recent years; and a study which at first was more or less local has now become one of world-wide scope.

Among the several branches of science which contribute to our understanding of the subject,

* From the presidential address to Section H (Anthropology) of the British Association delivered at Norwich on September 9.

those of palæontology and geology are of considerable importance. The period of man's existence on the earth has been so short that there has been no appreciable evolution among the mammals associated with successive human races; but many migrations and extinctions are observable, so that these mammals can often be used for determining the relative ages of the isolated deposits in which human remains and implements occur. In some cases also the mammals are probably enough to show the nature of the climate and the local conditions under which they lived. The contemporary geological changes, though small, likewise help in explaining migrations and perhaps some extinctions; while the peculiar circumstances of the Great Ice Age, under which early man flourished in the northern hemisphere, varied so much from time to time, that they have been used in forming a plausible chronology. As a palæontologist and a geologist, therefore, I propose to discuss some of the latest developments of prehistory.

It has long been recognised that the earliest men of which traces have been found in Europe did not originate on this continent, but were immigrants from some other region. It is thus important to examine the numerous associated mammals to ascertain whence they came; for most of these mammals seem also to have been immigrants to Europe just before or during the Pleistocene period when man began to live here, and they may give a clue to his origins.

Sir W. Boyd Dawkins was one of the first to take a broad view of the mammals which accompanied the successive races of early man in Europe, and he eventually published a map to illustrate their mixed origin. In addition to some which were already in the middle of the European continent, others seemed to have come south from the Arctic regions, others had passed directly west from the middle of Asia, while a few could only be explained as having come north from Africa over old land bridges to Gibraltar and southern Italy. These mammals might not all have lived together, but they at least showed how varied were the routes open to the movements of primitive men.

It now appears that the tracing of the warmer types of mammals to an African source was a mistake. Recent researches seem to have proved that during the Pleistocene period there was no direct communication between Europe and Africa, either through Gibraltar or through Sicily and Malta. Geologists are satisfied that certain shells which are characteristic of northern seas could not have entered the Mediterranean to be found there in Pleistocene sea beaches if the Straits of Gibraltar had not been open. Others have remarked that among the numerous remains of mammals which occur in some of the caves at Gibraltar, there is nothing distinctly African. Dr. Raymond Vaufrey has more recently examined the fossil mammals and stone implements found in the caves and other Pleistocene deposits of Sicily and Malta, and he shows clearly that although these islands were connected with Italy at the time, they never had an extension to Africa.

The latest discoveries of fossil mammals in the caves of Palestine and Syria, as interpreted by Miss Dorothea M. A. Bate, show that during the early half of the Pleistocene period, Asia and north Africa were much more closely connected than they have been since. The country was comparatively well watered, with luxuriant vegetation and forests, and mammals could readily migrate both east and west. Even so characteristic an African animal as the wart-hog (*Phacochœrus*) was then living in Palestine. The connexion of Asia with Africa was thus as definite as that with Europe; and the explanation of the partial identity between the Pleistocene mammals of Africa and Europe is probably that they had a common source in Asia, and diverged west in two different directions, one southwards, the other northwards.

This conclusion is supported especially by the apparent origin and former distribution of the spotted (or cave) hyæna, *Hyæna crocuta*. In the Pliocene deposits of the Siwalik Hills in northern India, there are jaws and other remains of hyænas which are not quite *H. crocuta*, but may well represent its ancestors. By the Pleistocene period, the typical *H. crocuta* was already in existence in India, as shown by a tooth discovered in the Karnul caves, Madras. Remains of the same species have also been found in Pleistocene deposits in central Asia and even in China. They are likewise widely spread over Syria and northern Africa, where only the striped hyæna (*H. striata*) lives to-day. *H. crocuta*, therefore, is not an African animal. It originated in Asia, spread thence in different directions in the Old World, and has survived only in southern Africa, which is at one extremity of its former wide range.

It is also to be observed that none of the characteristically African antelopes occurs among the European Pleistocene fauna. Remains of the gazelle have been found, but this animal is as much Asiatic as African. The Saiga antelope and *Nemorhœdus*, which are Asiatic to-day, are the only other antelopes which reached Europe in Pleistocene times.

The Pleistocene mammals of Europe, therefore, show that when they flourished on this continent, the only direct land communication was through Asia. The earliest races of men must have reached western Europe by that route, and as a succession of stone implements, remarkably similar to that

which is now so well known in Europe, has already been found with early Pleistocene faunas in Africa, it might at first be supposed that there were parallel migrations of the same men from the Asiatic to the African continent. Implements, like languages, however, afford no certain clue to the races which made and used them, and the same tools must have been invented independently more than once. It is therefore unfortunate that hitherto no human remains have been found in undoubted association with any of the earliest implements and Pleistocene mammals in Africa.

Two years ago a committee of geologists which met in Cambridge expressed itself as satisfied with evidence which Dr. L. S. B. Leakey submitted in order to prove that he had discovered modern types of human skull and lower jaw with very primitive implements and early Pleistocene mammals in Kenya Colony. In fact, it appeared as if the same types of implements in the same geological stage in Europe and Africa had been made by two distinct genera of men. Quite lately, however, Prof. P. G. H. Boswell, under the guidance of Dr. Leakey, has examined the geological formations in the region where the discoveries were said to have been made, and he is now convinced that there is no proof of the association which has been claimed. The human remains in question seem to have been obtained from disturbed deposits, and may have been buried at a comparatively recent date. With later types of stone implements and remains of modern mammals, the only satisfactory fragments of the human skeleton which have hitherto been found in Africa belong to the genus *Homo*. Many of the fossil forms are related to the surviving South African bushman, and if any of these passed directly from northern Africa into Spain, as has sometimes been supposed, they must already have learned to make rafts by which they could cross the Straits of Gibraltar.

The only fossil hitherto discovered in Africa, which suggests that that continent may have produced man, is the immature skull from a deposit of uncertain age (probably Pleistocene) at Taungs in Bechuanaland, which was named *Australopithecus* by Prof Raymond A. Dart in 1925. It belongs to an ape, and seems to exhibit more human characters than the skull of any of the existing apes; but Prof Dart's complete account of the fossil has unfortunately not yet been published.

The earliest known jaw of an ape, *Propliopithecus*, was discovered long ago in the Oligocene of Egypt, and numerous jaws of apes related to the existing chimpanzee are now being found in the Miocene of south-east Africa. Equally abundant, however, are the jaws of apes in the Mio-Pliocene deposits of northern India, and some of the teeth preserved in them exhibit a remarkable approach to those of man. I still think, indeed, that according to our present knowledge, the links which connected apes with man are most likely to be found in south-central Asia. As the late Joseph Barrell pointed out, the east to west ridge of the Himalayan Mountains was gradually raised up at the time when northern India was covered with a great forest which swarmed with apes of many kinds. The formation of the ridge separated off a northern portion of the forest which became subject to comparatively inclement conditions. The apes stranded in this northern portion would be disturbed by the extensive destruction of the trees, and the survivors would be driven to be ground-apes and change their habits of feeding. They would thus be modified in the direction of man.

These considerations, with the geographical distribution of the few oldest known remains of fossil man, led the late Dr. Davidson Black to make plans for a systematic examination of the later Tertiary deposits of south-central Asia. In 1925 he reviewed the whole subject in an important paper published by the Geological Society of China. In the summer of 1932 he actually traversed a route from eastern China, through northern India, to Syria and the western coast. Dr. Black, unfortunately, did not live to see the realisation of his project, but we are glad to learn that Father P. Teilhard de Chardin will take his place in researches beginning in India this autumn.

It is very interesting to notice that if central Asia was actually the region in which the human family originated, the few known fragments of the oldest fossil men are distributed geographically just as a palæontologist would expect them to be. The late Dr. W. D. Matthew pointed out that if each race of animals evolved at a single centre, a succession of waves of increasingly advanced genera must have radiated outwards from that centre. The latest and highest types would be found at the actual place of evolution, and they would be surrounded by rings of less advanced types of lower and lower degree until the lowest would occur at the outer limit.

The fragments of the oldest fossil men hitherto discovered are indeed very few, but although allowance for negative evidence may cause some hesitation, it is at least noteworthy that they are all on the periphery of the Euro-Asiatic continental area. *Eoanthropus* and Heidelberg man were found on the western margin of Europe, *Pithecanthropus* at the southern margin of Asia, and *Sinanthropus* close to the eastern coast of Asia. If human types were evolving near central Asia, the places of these actual discoveries are in a distant partial ring round the source.

The next stage in man's development is much better known, because by this time he had learned to bury his dead in security. As examples have been found in caves so far apart as France and Palestine, burial had doubtless become a general custom. Many whole skeletons are therefore available for study.

This stage is that of Neanderthal or Mousterian man, which is geologically the latest to retain several specially ape-like characters associated in a single individual. Its Asiatic origin is now still clearer to a palæontologist than that of earlier man. Burials in caves which seem to be approximately of the same date reveal a comparatively high Neanderthal type in Palestine, a low and bestial type in western Europe. On Matthew's principle already mentioned, the first is therefore nearest to the original source. The accompanying stone implements support this conclusion, for whereas in western Europe the implements are merely trimmed broad flakes, in Palestine there are also many narrow blades which resemble those made by later (Aurignacian) man in Europe. The Asiatic type of Neanderthal man was indeed progressing in skill to meet his increasing needs. He appears to show us modern man in the making.

Until typical *Homo sapiens* had come into being, man's only outlet from Asia seems to have been by land in the direction of Europe and Africa. As soon, however, as he had attained this final stage of development he must have been able to construct rafts or boats, by which he crossed the narrow seas of the East Indies to Australia, and perhaps the equally narrow seas at Bering Straits to North America.

Australia is shown by its past and present animal life to have been separated by sea from the rest of the world during the whole of the Tertiary era, including Pleistocene times, and it was isolated too early to be inhabited by the ancestors of the apes. Man is therefore certainly an immigrant from overseas, and we know that he reached the country when various relatively large Pleistocene marsupials were still living there, because a fossil human skull has been found at Talgai in Queensland directly associated with their remains. This skull is essentially the same as that of the existing Australian aborigines, who have retained a mode of life like that of the latest Palæolithic hunters of the mainland.

It is remarkable that very few traces of men who might be related to the ancestors of the Australians have hitherto been recognised in their homeland in Asia. The skulls of *Homo wadjakensis* from an old lake deposit at Wadjak in Java, discovered and described by Dr. Eugene Dubois, may perhaps be placed among them. The skulls named *Homo* (*Javanthropus*) *soloensis*, more recently discovered by Dr. W. F. F. Oppenoorth in an old deposit near the Solo river in Java, seem to be intermediate between the skulls of *Pithecanthropus* and the modern Australian, though they have not yet been described in detail. As many have observed, the skull of Rhodesian man (*Homo rhodesiensis*), from a cave in northern Rhodesia, also exhibits several resemblances to the skull of the modern Australian. Other skulls dug up in South Africa have also been described as exhibiting Australian characteristics. Sooner or later, therefore, fossil ancestral types of Australians will probably be found widely distributed in the tropics of the Old World.

In at least part of the first half of the Pleistocene period there must have been a direct connexion between Asia and North America in the region of Bering Straits. There may have been an isthmus of land, or there may have been only islands and continuous ice; but there was certainly a passage which allowed such mammals as the mammoth, bison, sheep, goat, elk, wapiti, reindeer and black bear to reach America for the first time. So far, there is no evidence that man accompanied these animals, and it may be that by then he had not yet reached the north-east corner of Asia. The woolly rhinoceros similarly never passed from Asia to America, although it was abundant and widely spread through the northern lands in the Old World. Its absence from America shows that in come cases there were impediments to emigration.

The earliest traces of Palæolithic man hitherto discovered in North America date back only to the later part of the Pleistocene period. Last year, Mr. J. Dorsch, when collecting for Mr. Childs Frick, found at Fairbanks, Alaska, some small end-scrapers and conical cores, which Dr. N. C. Nelson recognised as identical with those which he had collected a few years before in large numbers in the Gobi desert. These seem to have been made by some of the latest Palæolithic men; and the only stone implements hitherto found in North America in direct association with the remains of typically Pleistocene mammals show that, when man arrived in that country, he had already learned the supreme art of trimming stone by pressure-flaking. In pattern, indeed, his implements resemble those of Solutrean man in Europe, and even include the familiar Solutrean leaf-shaped blades, besides the characteristic spear points. They have lately been satisfactorily proved to be contemporaneous with extinct mammals of Pleistocene age in several localities, especially in New Mexico, Texas, Colorado, Nevada, and Nebraska.

Some of the typically Pleistocene mammals in the southern part of South America appear to have survived until comparatively recent times.

Man was almost certainly associated with them, but nothing is known to distinguish this race from modern South American Indians. The supposed ancestors of the human family reported by Florentino Ameghino from the Tertiary rocks of Argentina are due to erroneous interpretation of the fossils, as already pointed out by Hrdlička and others.

The first fossilised remains of man in the South American continent were discovered exactly a hundred years ago in the caves of Minas Geraes, Brazil, by the Danish naturalist, Dr. Peter Wilhelm Lund, whose centenary has just been celebrated by the scientific men of Brazil in Lagoa Santa and Bello Horizonte. Under the direction of Prof. Anibal Mattos, three volumes have been published in Bello Horizonte, giving an account of Lund's researches, with a Portuguese translation of his scientific papers.

Some years ago the late Dr. Francisco P. Moreno, Dr. Rudolf Hauthal and I, described the discovery of the dried skin and other remains of an extinct ground sloth (*Neomylodon* or *Grypotherium*), with fragments of other extinct mammals, in a cave in Last Hope Inlet, Patagonia. Here again, the presence of fires, cut and worked bone, and masses of hay cut for food for the ground sloth, led us to infer that man lived in Patagonia with the various Pleistocene mammals which are now extinct.

The races of men who eventually reached New Zealand and other remote islands were so far advanced in civilised life that they scarcely concern a palæontologist. They only interest him on account of the disturbance of the existing wild life and the extinctions which they have caused. The ethnologist now joins the human anatomist in attempting to explain the distribution of these people and to discover their relationships. They occupy a lowly sphere in the *modern* world.

The Meaning of Probability

By Dr. Herbert Dingle

THE subject of probability originated in the consideration of actual but trivial problems. Its obvious attractions as a field for the exercise of mathematical ingenuity soon gave it a predominantly mathematical aspect, and in spite of its application to certain practical activities such as those of insurance companies, and its significance for statistical mechanics, it has until recently been treated as a branch of pure mathematics. Nevertheless, the word has a meaning in ordinary life among those who never concern themselves with mathematics. Such people have often to act without sufficient knowledge to predict with certainty the effect of their actions, and they do so in accordance with the 'probabilities' of the case. They do not calculate a numerical magnitude; they simply act in the way which they feel to be 'most likely' to produce the result they desire. Obviously, it is desirable that the precise scientific definition of probability should approximate as closely as possible to the pre-existing, indefinite conception which directs the majority of our actions. If it does not do so, it is not necessarily illegitimate mathematically or even physically, but it would then be better represented by another word.

Now in recent years probability has entered physics in a much more vital way than previously. This introduces another complication. In order to obtain physical credentials, concepts have now to satisfy certain conditions which mathematics does not impose, and, as we shall see, probability in its customary mathematical sense does not necessarily satisfy those conditions. We have therefore a threefold aspect of probability—an ordinary, everyday aspect, a mathematical aspect and a physical aspect; and unless hopeless confusion is to result, we must either use the word only to represent a conception which is satisfactory from all three aspects, or, alternatively, restrict our application of any narrower conception we may employ to those fields to which it legitimately belongs.

We must notice, however, that even when we have done our best to be precise, the question necessarily retains some vagueness—for two reasons. In the first place, when one wishes to convert an indefinite into a precise conception, one has obviously a certain latitude of choice, just as there was a certain latitude of choice in selecting a particular 'unknown soldier' to represent the general war hero. This affects our attempt to frame a mathematical or physical definition agreeing with our everyday use of the word. In the second place, the very idea of probability, however precise it is made, has an intrinsic vagueness, since, unless it has the value 1 or 0 (speaking in terms of the ordinary mathematical definition), it cannot be inconsistent with any single experiment made

to test it. This affects our attempt to make the physical equivalent to the mathematical definition.

Both these difficulties are well illustrated by the problem which is the subject of discussion between Dr. T. E. Sterne and myself[1]. That problem is as follows: "If A and D each speaks the truth once in three times independently, and A says that D lies, what is the probability that D speaks the truth?" Let us consider first the relation of the mathematical to the everyday treatment of this problem; we will consider its relation to the physical treatment later.

We have here an event (D's remark) to which we want to assign the probability that it has a certain characteristic (truth). We have two independent pieces of information bearing on it: (1) statistics concerning D's statements; (2) a comment by A, whose character is known. The difference between Dr. Sterne and myself is that I regard these pieces of information as completely independent, so that any combination of them is purely artificial, whereas he puts them in the same class, obtains a probability by combining them, and claims that it is significant because it is unambiguous.

Now, as we have seen, there is no final proof one way or the other. I would say that a probability derived from either (1) or (2) by itself would be within the limits of ordinary conceptions —like taking two different victims of the Battle of the Marne for the unknown soldier—but that a probability derived from a combination of (1) and (2) would go outside those limits; it would correspond to the choice of, say, a Crimean warrior. The essential vagueness of the first kind prevents a rigid proof of this, but I can give examples to show where, as it seems to me, Dr. Sterne has been misled.

In combining (1) and (2), Dr. Sterne is combining data which have an obvious but inessential resemblance: they are both concerned with people's statements. But those statements are used in different ways. D's character gives us a statistical probability, but A's character, *in reference to the statement of D in question*, has no statistical aspect; the datum would be unaltered if D had never before spoken. In my review of Sir Arthur Eddington's book, "New Pathways in Science", which originated this discussion[2], I tried to make the two sources of data as distinct as possible by citing an analogous problem involving the 'statistical' and the 'cause-and-effect' probabilities of a horse's success in a race. Here the essence of the problem is the same—we have still two independent sets of data bearing on a particular event—but, the irrelevant superficial resemblance having been removed, it is clear that a combination of those data is quite artificial.

What one does in such problems is, it seems to me, to choose first which kind of data to trust, and ignore the other. A gambler, I imagine (I confess to inexperience in these matters), usually decides in favour of the horse that seems most likely to win, and ignores statistics of what has happened to such horses in the past. Another example may make the point even clearer. If Ohm's law has been experimentally verified 9,999 times out of 10,000, and P, who speaks the truth once in 10,000 times, says that it is true, what is the probability that it is false? My own opinion is that no one would pay any heed to the unspeakable P, but Dr. Sterne's method would give a probability $\frac{1}{2}$—that is, the law would be as likely to be false as true. In the problem of D's statement, I am convinced that if there were any hesitation in one's mind, it would be whether to put trust in A or D: it would have nothing to do with any combination of their testimony.

Let us, however, turn to the physical question, which is by far the more important. One of the chief features of modern physics is the conscious realisation and practice of the principle that no statement shall be accorded physical meaning unless it can be tested by physical experiment. It was on this ground that Einstein rejected the notion of absolute simultaneity of spatially separated events: since there is no physical means of determining absolutely if two such events are simultaneous, there is no meaning in calling them so. It was on the same ground that Heisenberg rejected the simultaneous evaluation of certain conjugate characteristics of a mechanical system: since there is no means of determining, for example, the precise momentum of the system at a definite position in space, there is no meaning in saying that the system has simultaneous position and momentum.

The essential vagueness of the second kind mentioned above therefore seems to rule out probability as a physical conception. If we state that the probability that a certain event will occur is $\frac{1}{3}$, then our statement cannot be checked by seeing if it does occur: whether it occurs or not, the statement may still be either true or false. Yet, in spite of this obvious disqualification, probability has stepped into the place vacated by conceptions which the principle in question has expelled. What is the explanation?

It is simply that probability in physics is purely symbolical: it is a metaphor expressing certain experimental results. For example, we find by experiment that in certain definite circumstances a screen is twice as brightly illuminated at one place, A, as at another, B. Now begins the metaphor. We imagine the light to consist of groups of 'photons', to which we assign the

property of illuminating the screen in proportion to their number; hence we must imagine that twice as many photons fall on A as on B. To enlarge our conception we ask why this is so, but we can get no answer. We must therefore rest content with saying that the 'probability' that a particular photon will go to A is twice as great as the probability that it will go to B. We cannot justify this physically if it is taken in any literal sense because, as we have seen, it cannot be tested. It has physical meaning only if we take it as a metaphorical expression of what we observe. We express the *observed behaviour of many* (arbitrarily imagined) photons by attaching a *hypothetical property to each* of them.

Let us now test the physical reality of the probabilities involved in our problem. The records of D's statements alone give a result (let us call it the 'probability'), $\frac{1}{3}$. A's comment alone gives a result (the 'likelihood'), $\frac{2}{3}$. Dr. Sterne's "association table" gives a result (the 'chance'), $\frac{1}{2}$. The probability and the likelihood are obviously real, for they symbolise the results of experiments which have been made. The chance, however, is in different case. It purports to mean, as Dr. Sterne himself says, that if A says many times that D lies, half of his comments will be true. But there is no experimental evidence for this, for the data do not tell us that A has made more than one such comment. We cannot, furthermore, make an experiment to test it (strictly speaking, a superfluous consideration, for 'chance' is intended to represent not prediction but existing fact), for even if we could bring A and D together, make D speak many times, and induce A to comment on each of his remarks, we could have no guarantee that the conditions would not violate the postulate—that, in fact, A and D would continue to speak truth or lie 'independently'. Hence 'chance' can have no physical significance, for it symbolises, not experimental results but a mathematical process.

The questions involved in this discussion are far more important than may appear on the surface. If the chapter on probability in Sir Arthur Eddington's book had been merely an account of a mathematical theory, it would, in spite of its interest and value, scarcely have called for lengthy controversy in a general scientific journal. It was included, however, because of the importance of probability in modern physical theory, and the reader would naturally suppose that what he was reading about had a physical application. This is a relatively harmless example of one of the most regrettable characteristics of our time. Probability, which enters physics as a symbol for expressing actual observations, emerges in scientific romances, amid the blare of trumpets, dressed as a general custodian of any sort of knowledge or rumour that may drift along, and purely objective systems are spoken of as 'waves of knowledge' or 'waves of probability', as though inorganic Nature is altered when someone speaks about it. The consequence is that the general public is led to believe that Nature is dissolved into pure subjectivity.

It is all the result of allowing mathematics, which is a good servant, to become a bad master. Instead of observation, the true test of physical reality, we are offered mathematical uniqueness. So insidious is this evil that Dr. Sterne appears to find it incredible that I describe as a "meaningless mathematical function" an expression which is immediately seen to be so by the foremost criterion of the physics in which he himself has done such brilliant work. It has even been suggested that mathematics is divine, when it is not even physical. It is much to be hoped that the true relations between mathematics and physics will be clarified, for the sake of both physical progress and general understanding of recent advances of thought.

D's statement	C's statement	B's statement	A's statement
T 27	$D + T$ 9	$C \rightarrow D + T$ 3	$B \rightarrow C \rightarrow D + T$ 1
			$B \leftarrow C \rightarrow D + L$ 2
		$C \leftarrow D + L$ 6	$B \rightarrow C \leftarrow D + T$ 2
			$B \leftarrow C \leftarrow D + L$ 4
	$D - L$ 18	$C \rightarrow D - T$ 6	$B \rightarrow C \rightarrow D - T$ 2
			$B \leftarrow C \rightarrow D - L$ 4
		$C \leftarrow D - L$ 12	$B \rightarrow C \leftarrow D - T$ 4
			$B \leftarrow C \leftarrow D - L$ 8
L 54	$D - T$ 18	$C \rightarrow D - T$ 6	$B \rightarrow C \rightarrow D - T$ 2
			$B \leftarrow C \rightarrow D - L$ 4
		$C \leftarrow D - L$ 12	$B \rightarrow C \leftarrow D - T$ 4
			$B \leftarrow C \leftarrow D - L$ 8
	$D + L$ 36	$C \rightarrow D + T$ 12	$B \rightarrow C \rightarrow D + T$ 4
			$B \leftarrow C \rightarrow D + L$ 8
		$C \leftarrow D + L$ 24	$B \rightarrow C \leftarrow D + T$ 8
			$B \leftarrow C \leftarrow D + L$ 16

If, after this, I may be allowed a word on the purely mathematical question, I would say that, if I have understood Dr. Sterne's contingency table aright, I do not agree with him that it cannot be constructed for Sir Arthur Eddington's original problem. If that were so, it would of course indicate a defect of his method of treatment, because the problem (if we allow the assumption, which must be made in the simplified problem as well as in this, that if D does not lie he necessarily speaks the truth) is unambiguous. I had, however, constructed what I believe to be such a table before his first letter appeared. It is given above.

81 statements by D are considered, and each remark in the table is followed by "T" or "L", representing "truth" or "lie", and by the number of such remarks in the 81 cases. For brevity, the following symbols have been adopted:

→ means "asserts that"; + means "tells the truth";
← ,, "denies that"; − ,, "lies".

It will be seen that only lines 6 and 10 of A's statements satisfy the conditions of the problem, giving 4 cases in which D lies to 4 in which he speaks the truth, so that the 'chance' that D speaks the truth is $\frac{1}{2}$, as in the simplified problem. (Incidentally, it will be noted that A lies every time he makes the statement in the problem, so that it would appear to be impossible for B to deny that C declares that D lies—further evidence of artificiality.)

The "likelihood" I calculate as follows:

The probability that A tells the truth is $\frac{1}{3}$. Hence the probability that B denies that C declares that D lies is $\frac{1}{3}$.

If B denies that C declares that D lies, the probability that his denial is false (that is, that C does declare that D lies) is $\frac{2}{3}$. Hence the absolute probability that C declares that D lies is $\frac{1}{3} \times \frac{2}{3} = \frac{2}{9}$.

If C *does* declare that D lies, the probability that D tells the truth is $\frac{2}{3}$. Hence the absolute probability (that is, the 'likelihood') that D tells the truth is $\frac{2}{9} \times \frac{2}{3} = \frac{4}{27}$.

The 'probability', of course, is $\frac{1}{3}$.

[1] NATURE, 135, 451, 1073; 1935. 136, 301, Aug. 24; 1935.
[2] NATURE, 135, 451; 1935.

News and Views

British Association: Officers and Meetings

AT the meeting at Norwich of the General Committee of the British Association, Sir Josiah Stamp, General Treasurer of the Association, was elected president for 1936. Sir Josiah, who is chairman of the London Midland and Scottish Railway, was president in 1930–32 of the Royal Statistical Society and enjoys an international reputation as an economist. The office of General Treasurer of the Association has been filled by the election of Prof. P. G. H. Boswell, until now one of the General Secretaries. Prof. F. J. M. Stratton, the other General Secretary, decided not to offer himself for re-election, so it became necessary to appoint two new general secretaries. These offices have been filled by the election of Mr. F. T. Brooks, reader in mycology in the University of Cambridge, and Prof. Alan Ferguson, assistant professor of physics at Queen Mary College, London. The new members of council are Lord Bledisloe, Prof. W. G. Fearnsides, Prof. Julian S. Huxley, Prof. R. Robinson, Dr. C. Tierney and Sir Gilbert Walker. Future meetings of the Association are announced for Blackpool (1936), Nottingham (1937), Cambridge (1938), Dundee (1939) and Australia (1940); and it is suggested that a selected party be sent in the winter of 1937–38 to take part in the jubilee meeting of the Indian Science Congress.

A Darwin Commemoration

SECTION D (Zoology) of the British Association devoted the afternoon of September 6 to the commemoration of the centenary of the landing of Charles Darwin on the Galapagos Islands, and of the birth of the hypothesis of the "Origin of Species". He landed on September 16, 1835, and during the five weeks he spent in the archipelago his observations included those on birds and reptiles recorded in his note-book, as quoted by Mrs. Barlow in her letter published in NATURE of September 7, p. 391. The clear differences presented more especially by the finches and the giant tortoises found on the different islands, led Darwin to a highly important line of thought and to the realisation that his facts, if well founded, "would undermine the stability of species". In an introductory address, Sir Edward Poulton gave an outline of the observations made by Darwin on the fauna of the islands, as a result of which he became convinced that he must abandon the idea of the separate creation of species though he was then unable to account for their origin. Sir Edward then reviewed evolutionary thought during the past century, especially in relation to the theory of natural selection. Prof. J. H. Ashworth gave an account of Darwin as a student in Edinburgh from 1825 until 1827 with particular reference to the development of his early taste for natural history and collecting, and concluded that in Edinburgh Darwin laid the foundation of his knowledge of the science of natural history. Prof. G. D. H. Carpenter spoke on Darwin and entomology, and cited examples in support of the theory of natural selection. Prof. E. W. MacBride spoke on Darwin and the problem of the population of the Galapagos Islands, and expressed his dissent from Sir Edward Poulton's views on the value of natural selection as a cause of evolution. Mr. H. W. Parker gave an account of the present distribution of the reptiles in the Islands, pointed out that two of the species found by Darwin were extinct and the others by no means common, and that the danger of extinction of other species had been recently realised by the Government of Ecuador. We hope shortly to publish an account of this interesting commemoration.

Protection of the Galapagos Fauna

THE giant tortoises and large iguanid lizards, which are a noteworthy feature of the fauna of the Galapagos Islands, have been greatly reduced in numbers during the last hundred and fifty years on account of their value as a source of oil, meat and leather. Many species are already extinct, and the numbers of others have passed below that minimum limit beyond which a species is unlikely to recover. Their commercial importance has now largely disappeared, but a new factor has arisen which menaces not only the larger reptiles but also the whole fauna. Pigs, dogs, cats and rats, introduced by settlers and visiting ships, are rapidly multiplying and preying heavily on the indigenous population. The danger has been apparent for many years, but it is only recently that a group of American zoologists, associated with the American Committee for International Wild Life Protection, has prevailed upon the Government of Ecuador to enact legislation to protect the fauna. The British Association has expressed to the Government of Ecuador its deep appreciation of the action taken, and has instructed its representative at the forthcoming International Zoological Congress (Dr. W. T. Calman) to direct attention to the matter. Unfortunately, the full scope of the Ecuadorian decree is not at present known in England, but it seems that permission has been given for many of the islands to be set aside as Nature reserves, and for the protection of the native reptiles, birds and aquatic mammals throughout the entire archipelago. No provision appears to have been made for the enforcement of the decree, but it is hoped that an international committee may be formed to co-operate with the Government of Ecuador to achieve this end; Sir Edward Poulton and Mr. H. W. Parker having been nominated by the British Association as its representatives.

Science and Population Problems

SIR ARNOLD WILSON'S public lecture to members of the British Association and others delivered at Norwich on September 9, which dealt with "Science and Population Problems", was a striking illustration of the manner in which the Association may contribute to the discussion of current problems of public policy and government. On these occasions of general assembly of the members, a considered statement on broad lines reaches a wider audience than that to which it is immediately addressed, and in pointing out the bearing of the results of scientific research on the method of approach to a solution of difficulties of the day, it can help to mould public opinion on sane and enlightened lines. Thus, for example, Sir Arnold Wilson, although showing in the latter part of his address that he had in mind more particularly the practical measures dictated by scientific study for dealing with a stationary or falling population in Great Britain, indicated by his wide survey of the facts, so far as known, throughout the world, that population problems assume a different complexion when viewed as a whole. He restored the perspective, which has been lost in recent discussion owing to post-War developments, by reminding his hearers that if in certain countries a stationary or falling population is a menace, a vast proportion of the world population —in the East alone, at least one third—is in immediate or prospective danger of under-nourishment or even starvation through pressure of population and economic stress. This fact, which was patent before the War and was emphasised time and again by the late Prof. J. W. Gregory, has been allowed to fall into the background in the discussion of more insistent social and economic sectional problems. Its implications are no less grave than they were, and call as urgently as ever for consideration—possibly along the line of the scientific study of the distribution of commodities.

Further Exploration of Zimbabwe

NOTWITHSTANDING the general acceptance of the results of Miss Caton-Thompson's excavations in Rhodesia in 1929, a section of archæological opinion in South Africa still adheres to the view that the Zimbabwe are more ancient than was then shown, and the work of a people other than of Bantu stock. It will be remembered that when Miss Caton-Thompson submitted her results to the British Association, on behalf of which her excavations had been carried out, at the South African meeting in that year, Prof. Raymond Dart contested her conclusions, arguing for both the greater antiquity of the ruins and their lack of similarity to anything known in indigenous Bantu culture. An alternative suggestion is that they are of pre-Bantu origin, possibly the work of an Hamitic people under Arabian direction. Further research by South African archæologists, carried out after 1929, tends to confirm, rather than weaken, the view that structures of stone were not alien to early Bantu culture. Such, at least, is the origin attributed to ancient structures, which might, it is thought, have developed into the Zimbabwe, culminating in the unmortared granite towers and walls, thirty feet high and fifteen feet thick, of Great Zimbabwe. It is now reported from South Africa (*Observer*, September 6) that Prof. Dart, who has just returned to Johannesburg from Southern Rhodesia, proposes a further and more intensive exploration of Great Zimbabwe on a scale which will take five years for completion.

Romano-Celtic Temple at Colchester

FURTHER excavation on the Romano-British site at Colchester has revealed more fully the character and purpose of the remarkable enclosure and contained building discovered at Sheepen Farm on the banks of the Colne. The course of the northern wall has now been followed up, and the entire enclosure traced. It is found to be approximately rectangular in plan, except that the north-east corner has been deflected a distance of 155 ft., thus reducing the eastern face of the enclosure to a length of 180 ft. The total perimeter of the enclosing wall is roughly 511 yards. Further details of the enclosed building, of which the purpose is now evident, are given in a

report which appears in *The Times* of September 3. A stepped stone plinth, five feet square, in the centre of which there still remains *in situ* the base of a column of Purbeck marble, 1 ft. 3 in. in diameter, has been found approximately in the centre and in contact with the eastern face of the outer wall of the temple. The steps on the southern face of the plinth still retain portions of the original plaster, and on one fragment of the latter there are faint traces of colour. It is suggested that the column and plinth may be the surviving evidence of an altar which once faced the entrance of the temple. Flanking the plinth to the north and south, at approximately 11 ft. from the north-east and south-east corners of the outer wall respectively, are remains of packed rubble foundations, on which may have stood plinths of a similar nature to that which has been discovered facing the main entrance. At present, owing to their mutilated condition, and until further examination has been made, any conclusion would be premature. The drastic manner in which the temple was destroyed ultimately is, it is pointed out, indicated by the fact that only in the south-east corner of the wall of the *cella* does any portion of the original construction remain.

Funds for Archæological Exploration in Britain

SIR FREDERIC KENYON, in his first presidential address to the Society of Antiquaries of London, which now appears in full in the *Antiquaries Journal*, **15**, 3, stresses the difficulties which beset archæological excavation in Great Britain through the lack of men and money. Of the two, he feels constrained, and rightly, to lay greater emphasis on the latter. Few archæological excavations, he points out, are, like Verulamium, able to 'live on the country' and rely for any considerable proportion of their cost on a constant stream of visitors. Probably most excavators would regard such a solution of their difficulties as something of a calamity, in view of the constant interruption of their work. In the report of the Council, appearing concurrently with the presidential address, an appeal is made for support for the Society's Research Fund, which at present is not adequate to permit subvention of local funds by any amount which is more than an expression of goodwill. The Society is also faced for some time to come with responsibility for the excavation of Maiden Castle at Dorchester. Archæological exploration on any considerable scale is an especially expensive form of scientific research, and is usually beyond local resources. Sir Frederic suggests that the difficulties of the present situation might be met by the formation of a central fund, administered by such a body as the Society of Antiquaries through the machinery of the Congress of Archæological Societies. If this suggestion were adopted, it need not interfere with local interest, but should rather serve to stimulate it. It would also help to co-ordinate archæological research—a matter of no little moment; but not the least advantage it offers is that it would facilitate prompt action when, in these days of rapid development for building, it might be urgently necessary immediately to follow up some chance discovery.

International Congress of Pre- and Protohistoric Sciences

THE Second International Congress of Prehistoric and Protohistoric Sciences, in accordance with the decision taken in 1932 when the first session was held in London, will take place at Oslo in 1936. The Congress will meet early in August. Invitations and a preliminary statement are now being issued by the organising committee in Norway. The president will be Prof. A. W. Brøgger; and Juhs Bøe, Sigurd Grieg and Prof. J. L. Myres will act as general secretaries. The subscription has been fixed at 25 kr. for members and 12 kr. for associates. Enrolments and subscriptions should be addressed to the Bureau of the Congress, Universitetets Oldsaksamling, Oslo. Those who wish to contribute to the proceedings are requested to inform their national representative on the Conseil Permanent before March 1, 1936, and to forward an abstract of their communication to the organising committee before May next. The representatives of Great Britain on the Conseil Permanent are Prof. J. L. Myres, Sir Charles Peers and Prof. V. Gordon Childe (University of Edinburgh), and Mr. C. E. P. Hawkes (British Museum, Bloomsbury, London, W.C.1), secretaries. The organising committee announces that communications dealing with the topics which have been selected for discussion, as mentioned below, will be especially welcomed.

ON broad lines the arrangement of the proceedings will follow that of the London congress, when the members met in five sections, dealing respectively with human palæontology and the evolution of prehistoric man, the stone and metal ages in the ancient world and as found elsewhere, and the transition from prehistoric to historic. Special attention will be given to the discussion of certain Scandinavian problems in relation to the prehistoric archæology of Europe and the ancient world at large. The topics proposed, which were approved by the Conseil Permanent at Berne in December last, are: the excavations on stone age sites in Finmark of the last ten years, rock engravings in Norway and elsewhere, the Iron Age farms of Norway, the history of Teutonic art forms in the fifth and sixth centuries, and the textiles of Oseberg. It is possible that the domestic animals of prehistoric times and the origin of the runic alphabet may also be included, but this question has yet to be decided. The organising committee is anxious that problems arising out of these subjects should be discussed as thoroughly as possible on broad lines.

Co-operative Buying

IT is now generally recognised in large-scale business that considerable economies can be obtained through the establishment of a central purchasing department, and in the Second Report of the Committee on the Standardisation and Simplification of the Requirements of Local Authorities (H.M. Stationery Office. 6*d*. net), a similar policy is urged on local authorities. The larger local authorities are recommended to co-ordinate the buying of their various departments while smaller authorities are advised to co-operate with other

similar authorities or with larger neighbours. Co-ordinated or co-operative buying is, however, of much reduced value if it is not preceded or accompanied by a fair measure of standardisation and simplification whereby unnecessary variations of type, size and quality can be eliminated. Already the County Councils of Kent, London and the West Riding of Yorkshire have adopted complete centralisation of the buying functions in a supplies department which is independent of other departments; while the City Councils of Birmingham, Liverpool and Manchester have partially centralised the buying functions in those departments which are the largest users of the particular commodity. Manchester City Council saved £17,000 in 1933–34 by determining the best grade of fuel for the heating apparatus at its institutions (thereby halving the number of grades in use), and buying its fuel in bulk and by specification. The Committee strongly emphasises the point that bulk purchase if it is accompanied by standardisation and simplification enables better goods to be bought with less money, but that bulk purchase cannot be operated with maximum success unless the requirements of the buying unit are large enough to command large-scale buyers' terms and to employ experienced staff.

Influence of Industrialism on Mortality in Japan

IN a recent report of the Institute of the Science of Labour, Kurasiki, Japan (No. 29: (1) Sex-Ratio in the Population of Japan Proper; (2) The Influence of Industrialism upon the Mortality of Young People and Adults. By Dr. Sinzi Katuki. Pp. 30. Kurasiki: Institute for Science of Labour, 1935. 60 sen), Dr. Sinzi Katuki writing on the influence of industrialism upon the mortality of young people and adults shows that there is in Japan a close correlation between the female death rate in the age group 15–44 years and the rate of migration from the rural to the industrial areas. The death rate among women workers exceeds that of males in every industry except mining. Dr. Katuki concludes that these facts suggest the grave responsibility of industry for the heavy death rate of Japanese girls and young women. since in Europe and America, although employment of women is extensive, the female death rates are much lower than in Japan, absolutely and relatively to the male death rates. It would therefore seem that the high death rate of Japanese women in this age group is the result not of industrial labour in itself but of the bad conditions under which it is carried on and the insufficient protection of female workers. Recent statistics show a remarkable increase in the industrial occupations of women in Japan. Whereas formerly the great majority of women engaged in industrial employment regarded it merely as preparatory to marriage or only as a subsidiary means of subsistence, it has now frequently become their permanent and essential means of livelihood.

Synchronisation of Radio Stations

THE effect produced when a wireless set receives two different programmes on the same wave-length, although the stations may be widely apart, is sometimes called 'radio hash' in the United States. The Federal Communications Commission spaces two stations producing the same wave-length as widely apart as possible, but according to a report issued by Science Service, Washington, D.C., the whole country is spotted with these 'hash' or interference areas. In the June number of *Electronics*, the editor of which, Dr. C. H. Caldwell, was formerly a radio commissioner, a method of synchronising several stations on a given wave-length is described and thus space could be saved in the broadcasting spectrum. If the plan were carried out, no less than 1,527 radio stations could be constantly working in the present 106 channels. If all the stations, on a great nation-wide 'chain programme', broadcast only on three adjoining channels, 750, 760 and 770 kilocycles, for example, then it is only necessary to turn on one of these to get the corresponding programme. If one turns to other wave-lengths, then other chain programmes are obtained. In addition, low-powered stations, one kilowatt, for example, could be working —twelve to a broadcast channel—throughout the country. These programmes would be sharply differentiated from the 'chains'. Ten channels would be allotted to Canada, Mexico and Cuba, all of whom are asking for more space on the ether. For the American farmers there would be seven channels for superstations up to 2,000 kilowatts, so that every farmer, however remote, could hear. The 1,500 new stations could be heard with less interference than the few hundreds they would displace.

Express Highways in Germany

GOOD progress is being made in the construction of express highways (*autobahnen*) in Germany. An article in *Roads and Streets* gives an illustrated description of some of these highways and incidentally gives a photograph of part of an old Germanic plank road, built about 1000 B.C. and excavated a year ago at Bremen. The first 1,000 miles of the express highway has been completed. Most of it consists of a lawn strip 15 feet wide bordered by traffic lanes 25 feet wide on each side, the sides of the whole road having 'shoulders' sloping upwards. Trees and shrubbery are planted on the centre strip and on the shoulders. The shrubbery in the centre strip protects the driver largely from the glaring head-lights of cars travelling in the opposite direction. Densely wooded areas are relieved at intervals by small clearings giving views of distant landscapes. There are no crossings, viaducts or subways being provided so as to permit continuous and fast travel. Twelve of the German universities have laboratories for testing road building material. At Braunschweig there is a test track about 1,000 feet in diameter where tests are carried out on different types of surfaces under traffic conditions. The effects of the velocities of the vehicles on different types of tyres and the abrasion of the roads are all studied practically. The testing of materials for the eastern section of Germany, which is separated from the rest of Germany by the Polish Corridor, is done in the Free City of Danzig. It is hoped that the political difficulties which this Corridor will present to through traffic will soon be overcome.

Scientific Research in U.S.A.

In his report for 1933, the president of the Carnegie Institution of Washington has directed attention to the difficulties which beset scientific research during periods of political uncertainty and retrenchment. "Periods of emergency give rise to shifting conditions which may tend to press toward extinction of research and research institutions through financial weakening, and because of emphasis on what may be considered essentials of life." But on the other hand, emergencies present tests of adequacy in research as a method and of the human value of specific ideas for the origin of which it is responsible. The president says it is difficult to visualise a situation in which we could retreat from the present position. "The needs of civilisation can never be met by a static condition in which the generations merely settle down to life at a particular level. One can assume that through coming ages the requirement for increased knowledge with new ideas and their bettered application will grow. Unusual constructive ability arising out of what is known as the scientific interpretation will have an increasingly important part in development and organization of society. The investigation process, both as a means of securing ideas and as a method for learning their application, will naturally and properly take its place as one of the most nearly indispensable of all activities upon which the future well-being of mankind depends."

Cave Exploration

Now that the formation of a central body devoted to spelæological research in Great Britain holds out the prospect of a more systematic promotion of this branch of scientific studies, it is interesting to note the progress made in other countries towards the attainment of a like object. An article by M. R. de Joly, president of the Spéléo-Club de France, in *La Nature* of August 1 rapidly surveys recent activities in cave exploration, but touches in greater detail on the explorations in France of his own organisation. The Spéléo-Club de France was founded so recently as 1930, largely through the enthusiasm of M. E. A. de Martel; but already its members have explored or visited no less than six hundred caves, mostly in the Basses-Alpes, and some presenting considerable difficulties of penetration and no little risk to the explorers. One of the most remarkable feats of cave exploration to which M. de Joly refers was that of the great cave at the foot of the Guadalupe Hills, New Mexico—an area of which the cave exploration is now attracting no little attention in archæological circles in the United States in connexion with the association there of early man with a fauna now extinct. The cave of which M. de Joly writes, although discovered in 1901, was not systematically attacked until 1930, when a subvention from the *New York Times* made possible the organisation of an expedition of fifteen members to spend a fortnight underground. Notwithstanding difficulties of passage, no less than 51 km. were covered, including many chambers of enormous size. Another country which displays great activity in cave exploration is Italy, thanks to official financial support and the enthusiasm and friendly rivalry of a large number of local societies. Three thousand caves have been recorded as explored; and the Italians also hold the record for depth of descent. The Italian caves, indeed, are the deepest known, twelve being more than 250 m. deep, and four more than 300 m., while the deepest of all, the Bus della Preta, near Verona, has a depth of 620 m.

The Rabbit Menace

Wild rabbits have become so numerous in many parts of England that considerable alarm has been expressed by farmers and in the public press at the damage done to crops, pastures and young trees. The University of London Animal Welfare Society has for some years made a special study of the subject. It has now taken a useful and timely step in reprinting in Great Britain, by permission of the New South Wales authorities, a brochure entitled "The Rabbit Menace in Australia in 1933 and the Way Out", by David G. Stead, formerly special rabbit menace commissioner to the Government of New South Wales. The booklet brings strong confirmation to the views previously promulgated by the Society to the effect that the wild rabbit, considered as stock, does not pay, since the damage done by it far exceeds the price received by the farmer; that the trapping industry increases the stock of rabbits instead of diminishing it, and that control of the rabbit-population can be most efficiently (as well as most humanely) carried out by the use of calcium cyanide or similar products yielding hydrocyanic acid gas. The Society has issued several other publications on the subject of rabbit-control.

Treatment of Anæmias

We have received from Boots Pure Drug Co., Ltd., Nottingham, an illustrated booklet describing the different products issued by this firm for the treatment of the anæmias. 'Pepsac' is an active preparation of desiccated hog's stomach, which is given by mouth in pernicious anæmia: 'Hepostab' is an extract of liver specially prepared for intramuscular injection. It is suggested that treatment be commenced with 'Hepostab', especially if the case is a severe one, and continued from the fourth day onwards with 'Pepsac'. Each batch of 'Hepostab' is subjected to clinical trial before issue. Both preparations, and especially 'Pepsac', are of great value in the treatment of subacute combined degeneration of the spinal cord, the most severe complication of pernicious anæmia. Messrs. Boots also prepare liver extracts for oral administration, namely, compound fluid extract of liver—Boots, liquid extract of liver B.P., and dry extract of liver —Boots. For the treatment of secondary anæmias, 'Livron' is recommended: this is an extract of liver, yeast and malt with the addition of a full therapeutic dose of iron.

Medical Research in Egypt

We have received the third annual report of the Research Institute and the Endemic Diseases

Hospital, Cairo, for the year 1933. This shows that, under the directorship of Dr. M. Khalil Bey, much valuable work is being done on the endemic diseases and epidemiology of Egypt. One of the most interesting announcements is the discovery of the intermediate host of a human trematode or 'fluke' parasite, *Heterophyes heterophyes*, first discovered in 1851. The second intermediate host is a fish, in which the cysts of the metacercariæ were found in 1923, and from eating which human infection is derived. The first intermediate host has now been determined, and proves to be a fresh-water snail, *Pirenella conica*, which was found to be infected with the cercariæ of the parasite, and by eating this infected snail the fish become infected.

Lectures on the Rothamsted Experiments

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff are prepared to give lectures to chambers of agriculture and horticulture, agricultural societies, etc., on the Rothamsted experiments. No fee will be charged for the lecturers' services but any association engaging them will be expected to defray their travelling and hotel expenses and to make such arrangements for the lecturers as may be necessary. The following topics are offered by the member of staff indicated: soil micro-organisms (Dr. H. G. Thornton, Dr. Hugh Nicol and Mr. D. W. Cutler), agricultural botany (Dr. Winifred Brenchley), agricultural chemistry (Dr. E. M. Crowther and Dr. H. L. Richardson), soil physics (Dr. B. A. Keen and Dr. R. K. Schofield), entomology (Dr. C. B. Williams, Dr. H. F. Barnes and Mr. D. M. T. Morland), plant pathology (Dr. J. Henderson Smith, Miss M. D. Glynne and Mr. Geoffrey Samuel), fertilisers, manures, etc. (Mr. H. V. Garner). Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Announcements

THE late Prof. Ramon y Cajal has left a legacy of 25,000 pesetas to the Spanish Academy of Medicine to found a prize for the best work on a subject to be selected by the Academy.

THE Rockefeller Foundation has made the University of Chicago a donation of 243,000 dollars, of which 168,000 are to be spent on the foundation of a psychiatric clinic.

THE following appointments have been made by the Secretary of State for the Colonies: Mr. J. H. Harris, to be assistant chemist, Geological Survey, Tanganyika; Mr. C. W. S. Hartley, to be agricultural officer, Malaya; Mr. G. B. Masefield, to be agricultural officer, Uganda; Mr. A. F. McKenzie, to be agricultural officer, Sierra Leone; Mr. R. F. A. L. Reed, to be superintendent of agriculture, Nigeria; Mr. W. T. Dalgarno, agricultural instructor, Bahamas, to be superintendent of agriculture, Nigeria; and Mr. E. Williams, superintendent of agriculture, Gambia, to be agricultural officer, Uganda.

THE annual exhibition of the Royal Photographic Society will be formally opened by the president, Mr. Robert Chalmers, on September 13. The exhibition will be open to the public in the Society's galleries, 35, Russell Square, W.C.1, on September 14–October 12, from 10 a.m. until 9 p.m. (Sundays excepted), except Tuesdays and Fridays when it will be closed at 6 p.m., and lectures given. Admission to the exhibition is free.

THE twenty-second Congress of the Alliance of Social Hygiene will be held in Angers on October 4–6, when the following subjects among others will be discussed: Social medicine and traditional family medicine, extension of the work of social hygiene in rural areas, social value of open-air sports, anti-cancer and anti-venereal disease centres, the campaign against tuberculosis, old-age assistance and the declining birth-rate. Further information can be obtained from Prof. C. Metzger, 36 Boulevard Ayrault, Angers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant director of works in the Egyptian Irrigation Service in the Sudan—The Chief Inspecting Engineer, Egyptian Government, 41, Tothill Street, London, S.W.1 (Sept. 16).

A head of the Mechanical Engineering Department of the School of Engineering and Navigation, High Street, Poplar, E.14—The Education Officer (T.1), County Hall, S.E.1 (Sept. 16).

An examiner in the Aeronautical Inspection Directorate—The Secretary (S.2.d.), Air Ministry, Kingsway, W.2 (Sept. 19).

A head of the Chemistry and Natural Science Department and Vice-Principal of the Portsmouth Municipal College—The Registrar (Sept. 21).

A research assistant in physics in the University of Leeds—The Registrar (Sept. 23).

An advisory economist in the Seale-Hayne Agricultural College, Newton Abbot, Devon—The Principal (Sept. 25).

An assistant lecturer in mathematics in the Royal College of Science—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (Oct. 1).

Two assistants in cancer research—The Secretary, British Empire Cancer Campaign, 12 Grosvenor Crescent, London, S.W.1.

A lecturer in structural engineering and mechanics in the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

Part-time lecturers in automobile engineering, theory, practice, drawing and design in the Polytechnic, Regent Street, W.1—The Director.

An assistant lecturer and demonstrator in the Faraday House Electrical Engineering College—The Principal, Faraday House, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 439.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Age of the Universe

ONE of the most important problems of present-day astronomy is that of the age of the universe, and one of the most important pieces of evidence is provided by the orbits of binary stars. The ages which need to be seriously considered fall into two groups; the first is that of the so-called 'long' time scale, which is of the order of 10^{13} years, the time the stars would need to have reached their present condition by annihilation of their substance; the second is that of the 'short' time scale—which is of the order of 10^{10} or 10^{11} years, the time needed for the universe to have expanded from small beginnings to its present size. The motions of the stars ought to provide a means of deciding between the two. For dynamical discussion shows that with the long time scale both the linear motions of single stars and the orbital motions of visual binaries ought to show a reasonably good approximation to equipartition of energy; the short time scale, on the other hand, gives nothing like enough time for such an approximation to be established. Thus if the motions of the stars are found to show any marked approximation to equipartition of energy, it is exceedingly difficult to do other than decide in favour of the long time scale.

It is not easy to test the linear motions of the stars for equipartition of energy, for this requires a knowledge of stellar masses, and these are very imperfectly known. Nevertheless, so far back as 1922, Seares found that the linear motions of the stars show a tolerable approximation to equipartition of energy. It is far easier to test the orbital motions, since I have shown that if these conform to the law of equipartition, the number of orbits whose eccentricity is less than e will be proportional simply to e^2. The material collected in the recent new edition of Prof. Aitken's book "The Binary Stars" makes it possible to test this requirement with some accuracy. The agreement with the equipartition law is shown in the following table:

Orbits of Visual Binaries classified by Eccentricity

Limit of e	Observed	Equipartition
$e < 0.1$	0	2
$e < 0.2$	11	9
$e < 0.3$	20	21
$e < 0.4$	34	37
$e < 0.5$	58	58
$e < 0.6$	83	83
$e < 0.7$	89	113
$e < 0.8$	102	148
$e < 0.9$	109	187
$e < 1.0$	116	231

In the last column, the total number of stars has been taken to be 231, so as to make the number of orbits of eccentricity less than 0·6 equal to the number actually observed.

Inspection of the table now shows that up to this eccentricity, observation agrees well with the predictions of the law of equipartition; above it there is a marked deficiency of observed orbits. This deficiency can readily be explained by the well-known difficulty of detecting binaries of high eccentricity, and the still greater difficulty of measuring the elements of their orbits with sufficient certainty to justify their inclusion in a catalogue.

The agreement seems to me far too good to be accidental, so that the new material collected by Prof. Aitken would seem to provide strong evidence in favour of the long time scale.

Dorking. J. H. JEANS.
Aug. 31.

Blood Group Inheritance

FFOULKES EDWARDS and Etherington[1] put forward a theory of blood-group inheritance which amounts to the postulation, in addition to Bernstein's three allelomorphic genes causing the presence of one agglutinogen A or B or neither of them, of a fourth allelomorph producing both. This is intended to account "for the observed occurrence of a small percentage of groups AB and O in the offspring of $AB \times O$ matings".

Now supposing such occurrences to be inexplicable by "mistaken parentage or faulty technique" which the authors invoke in other exceptional cases, they might still be explicable by trisomy or by mutation. If AB individuals from such matings are much commoner than A or B individuals from $O \times O$ matings, the mutation hypothesis must be rejected. On the hypothesis of trisomy, the anomalous AB individuals have three chromosomes carrying the A, B and R genes, instead of the normal two. Such trisomy has, of course, been observed both in plants and animals.

The new theory may readily be tested. In the first place, no $AB \times O$ or $O \times AB$ mating should ever give more than two types of offspring, whereas on the hypothesis of crossing-over all four types might be expected. Secondly, an anomalous AB individual from such a mating should give only AB and O children when mated to a member of group O. On the hypothesis of trisomy, about two thirds of the offspring in such families should belong to groups A or B.

Similarly, the hypothesis of trisomy could be tested by Chrustschoff's[2] technique of observing mitoses in leucocyte cultures. Until one or both of these tests has been applied, it would seem that a suspension of judgment is desirable, Bernstein's theory being retained with the proviso that it may ultimately need modification.

University College, J. B. S. HALDANE.
London, W.C.1.
Aug. 30.

[1] NATURE, 136, 297, Aug 24, 1935
[2] Chrustschoff, *J Genet*, 31, 243; 1935

Metaphysics of the Physical World

RECENT letters to NATURE commenting upon Prof. Dingle's analysis of the Georgian era in physics express different views on the ultimate status of the physical world. The following discussion offers a foundation upon which all philosophers of science can agree. Philosophical differences arise if one seeks a deeper interpretation of the fundamental principles.

Prof. Dingle has shown that the new physics has been guided by a principle of observability: only those concepts that can be exemplified in observation are to be admitted in physical theory. The philosophical theory of logical positivism also employs the foregoing principle in the form of an empiricist criterion of meaning. The basic theory of the present discussion will conform to this principle.

The physical world consists of tables, chairs and other perceptible things. A thing is something of which aspects are given in perception. An aspect is an immediate datum of experience, for example, the visual aspect of a desk. Initially, the aspects of things are characterised by the fact that they can be given vividly in experience, but a more complete analysis reveals aspects to be functionally related to other aspects. Thus perception involves the vivid experience of aspects and the remembrance and anticipation of correlated aspects of a thing. Accordingly, our first principle concerning the physical world is that some physical things exist to which correlated sets of aspects belong which may be given in experience. The second principle is that the structure of things is exhibited in the structure of their aspects. These two principles suffice for a basic theory of the physical world. It is not possible to question the principles, since they are empirically discernible in the procedure of science.

It would accord with a positivist or empiricist philosophy to rest content with the foregoing principles. But traditional theory of knowledge, or epistemology, considers the ultimate relation between a thing and its aspects and their dependence on experience, and consequently yields a metaphysical theory.

The theory which has been favoured traditionally by natural scientific workers is dualism. The physical thing is assumed to be independent of experience and to produce its aspects by acting upon the observer. That aspects belong to a thing means that they are caused by the thing. Since the structure of an effect is determined by that of its cause, the structure of aspects manifests that of things. In contemporary discussion, dualism is sponsored by Sir Arthur Eddington.

Dualism was developed in the seventeenth century by Descartes and Locke. The empiricist criticism of it by Berkeley and Hume yielded subjectivism and phenomenalism. A thing was declared to be the set of its aspects which were assumed to be dependent on experience. Aspects belong to a thing in the sense of being members of the set of aspects constituting the thing; obviously, the structure of aspects exhibits the structure of things. The independence of things of experience is lost, and hence subjectivism and phenomenalism have been rejected by most philosophers.

In recent years, philosophers have made heroic efforts to work out a theory according to which experience directly presents an independent thing. The neo-realists, for example, have conceived of a thing as a set of aspects which are independent of experience. They thereby seek to retain the advantages of phenomenalism and dualism.

The three theories, dualism, phenomenalism and neo-realism, yield interpretations of the principles that the aspects of a thing belong to it and that the structure of things is exhibited in the structure of aspects. On dualism the two principles are hypotheses, on the two theories which assume direct experience of things the principles are definitions of a thing in terms of its aspects. It is impossible to decide empirically between the several theories, and on this ground the logical positivists would deny meaning to the problem and its solutions.

A position intermediate between the positivist theory which is expressed in our two fundamental principles and the several metaphysical views may be derived from Mach. The essence of a thing is the functional relation between its aspects. This functional relation is the independent feature of the physical things given in experience; the independent reality of the physical world resides in the independence of a system of laws rather than in the independence of substance. Whether one further holds with phenomenalism that aspects are created in experience, or with realism that aspects are merely revealed in experience, seems to be unimportant in that the issue cannot be decided empirically.

V. F. LENZEN.

Department of Physics,
University of California,
Berkeley.
July 31.

A Useful Application of the Principle of Heterogonic Growth

I HAVE come upon an interesting example of the way in which the application of the principle of heterogonic growth may simplify an involved problem. A certain measurement y of an organ or part of an organism is said to show heterogonic growth with respect to some standard measurement x of the organism when the equation $y = bx^k$ holds good over a definite period, b and k being constants typical for each particular case[1]. Heterogonic growth clearly involves a regularly continuous change of proportions.

This example concerns a well-known and widely-discussed study by the late Prof. Weldon on the shore crab, *Carcinus mœnas*[2]. In three different years, 1893, 1895, 1898, he made accurate measurements of frontal width (between the two most anterior 'teeth' on the anterior edge of the carapace) and carapace length, in a large number of young males covering the range 10–15 mm. carapace length, taken from a particular patch of beach in Plymouth Sound. Grouping the data by intervals of 0·2 mm. carapace length, he observed that with increasing size the mean relative frontal width became smaller, and concluded that some selective agency was acting against individuals with a relatively wide frontal aperture, the intensity of selection being assumed to increase with growth. The theory was apparently supported by the asymmetrical curves of distribution of individuals in each group. In the years 1895 and 1898 the frontal width was progressively less at the lowest size and its relative diminution with increase in body size was correspondingly more marked. Selection was assumed to have produced a progressive

change in the average initial proportions of the offspring and, in addition, the intensity of selection was increasing year by year.

This led Prof. Weldon to suspect that silt in the Sound, which was increasing steadily since the building of the breakwater, was the selective factor, and this he claimed to prove by laboratory experiments; crabs with relatively wide frontal apertures died, their gills covered with silt. Apparently an excellent example of effective selection in Nature, it has already been criticised on various scores by the late Mr. J. T. Cunningham[3] and others.

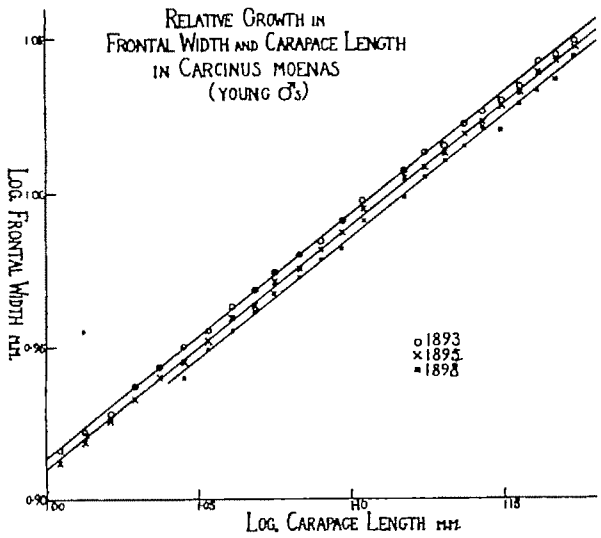

FIG. 1.

Now when the figures are plotted double-logarithmically, frontal width against carapace length, they give a straight line indicating heterogonic growth. The change of proportions which accompanies growth therefore occurs in every individual and automatically, not merely in the group-average, as a result of natural selection. The increase, with growth, of the annual differences, is similarly automatic, given the initial differences in proportion (measured by the constant b). The graphs for the three years are three parallel straight lines (Fig. 1), indicating identical heterogonic growth with a constant growth-coefficient, ($k = 0{\cdot}8$).

The constant b is the only quantity responsible for the differences between different years. However, data are required for more than three years to show whether or not its diminution is continuing. In any event, an explanation is required of its variability. This may be the effect of a variable external condition acting on early development, or even earlier, on the egg, through the parents. Analysis on the basis of heterogony has clarified and narrowed down the problem. In conclusion, it is of interest that young females differ from young males of the same year (1893)[4], but only in the constant b.

A. E. NEEDHAM.

Department of Zoology and
Comparative Anatomy,
University Museum.
Oxford.

[1] J. S. Huxley, "Problems of Relative Growth", London, 1932.
[2] W. F. R. Weldon, Section D, *Brit. Ass. Rep.*, Bristol, 1898.
[3] J. T. Cunningham, "Modern Biology", 1928.
[4] W. F. R. Weldon, *Proc. Roy. Soc.*, 57; 1894.

Incidence of Rickets in Rabbits

IN the Medical Research Council's Monograph "Vitamins: A Survey of Present Knowledge" (1932) it is pointed out that in Nature, rickets in rabbits is probably unknown, but can be easily produced under laboratory conditions. Furthermore, we can state that under normal conditions of management, the ordinary tame rabbit, as kept in hutches, is also free from the disorder. At this centre, about two thousand or more tame rabbits have been bred, and only three cases of rickets have been seen in the normal stock in nine years; two were in large varieties and one in a medium.

During the years 1927–29, importations of a new class of rabbit, namely, the 'Rex', with fur like the mole and which behaves as a recessive to normal fur, was imported from France and Germany, and this Institute purchased one Castorrex male and a trio of F_1 generation from Rex crossed normal coated stock, all from the same breeder. From the progeny of these animals, a number of rachitic animals appeared. Intensive breeding methods were followed in experimental fur production[1]. The male Rex was mated to normal coated does in May and June, 1929, and from 10 litters, 38 F_1 were grown to adults, from which 9 male and 19 female F_1 were selected for inter-breeding, and from February 1930 until September 1931, produced 524 F_2, in addition to certain other youngsters.

Of the F_2 generation, approximately one per cent of the *rex coated* rabbits had badly malformed forelegs, the condition resembling severe rickets, one *or* both forelegs being convex (bowed), whilst others, less severely affected, had one *or* both forelegs concave (knock-kneed). Closer examination showed some slight abnormality in a few of the normal-coated animals, but in no instance were these more than slight defects. Afterwards some adults were killed for post-mortem examination in the Veterinary Laboratory, and the severe cases confirmed as rickets, whilst a slight case was not confirmed.

Examination of the breeding records showed that rachitic animals occurred mainly in the fourth and subsequent litters, and that the disorder occurred mainly in large families. The average number of young for normal litters was 6·3, for litters in which concave forelegs appeared, 6·9, and for litters containing convex forelegs, 7·4. There was, however, one litter of one with the right foreleg pronouncedly convex. Of 99 F_2 examined for abnormal forelegs there were 79 normal furred and 20 rex furred, of which 10 normal furred (6 were slight cases) and 3 rex coated were concave; and, 3 normal and 9 rex were convex, which is a ratio of 2·96 normal legged to 1 abnormal (rachitic). Other breeders of rex coated rabbits also reported somewhat similar cases of rickets in rex coated but not in normal coated stock. It was, therefore, decided to investigate the possible inheritance of the rachitic condition to see whether it behaved, as indicated, as a simple Mendelian recessive character. However, attempted matings of rachitic with rachitic indicated absence of sexual desire, and in no case would severely rachitic animals copulate with one another.

W. KING WILSON.

National Institute of Poultry Husbandry,
Newport, Shropshire.
Aug. 9.

[1] "Rex-Furred Rabbits", Bull. 78, Ministry of Agriculture, 1934.

Ascorbic Acid (Vitamin C) and the Germination and Growth of Seedlings

SCARCELY anything is known regarding the phytobiological role of vitamin C in the life of the higher plants, and so far as I am aware, no attempt has been made to investigate experimentally their responses when treated with this substance.

The experiments outlined in this note involved the examination of some 2,500 seeds and seedlings. The seeds were germinated on filter paper in Petri dishes, and both these and the seeds were sterilised. The ascorbic acid was dissolved in sterilised distilled water and 3–5 c.c. of this solution was added daily to each Petri dish containing 40–50 seeds. The filter-paper of the controls was moistened with the same quantity of sterilised distilled water. No nutrient substance was supplied, and the experiments were concluded when the reserves of the seeds were exhausted (generally in 12–13 days). The average total amounts of ascorbic acid supplied during this period were, for the different concentrations used, namely, 1/10,000, 5/10,000, 2·5/1,000 and 5/1,000, 4 mgm., 20 mgm., 95 mgm., and 150 mgm.

The observed effects on wheat were as follow. With concentrations of 1/10,000 and 5/10,000: no stimulation of germination, but an acceleration of growth and an increase of 25–30 per cent in the length of the shoots. At the end of the experiments, the weight of the shoots of the treated plants—as compared with the controls—showed an increase of 25–30 per cent and that of the roots an increase up to 50 per cent. A concentration of 2·5/1,000 exercised a slight inhibitory effect upon germination and a very marked one (24–45 per cent) upon the growth and weight of the seedlings. The concentration of 5/1,000 proved to be practically lethal.

Oats were much less sensitive both as regards the stimulatory and the inhibitory effects of ascorbic acid. On the other hand, it was noticed that upon seedlings of plants—such as tomato and paprika—which have naturally a high vitamin C content, a concentration of 5/10,000 was enough to exercise inhibitory effects.

Adult tomato plants treated with a 1/10,000 concentration of ascorbic acid showed no acceleration of growth and flowering, but although the number of fruits produced was less than in the controls, their total weight was 20 per cent greater.

Titration of the vitamin C content of the treated seedlings and tomato plants revealed no increase as compared with the controls.

LÁSZLÓ HAVAS.
Hungarian Biological Research Institute,
Tihany, Hungary.
Aug. 8.

Swarming of *Vorticella*

WE have observed a phenomenon of swarming in two common species of gregarious vorticellids which has apparently not been recorded hitherto.

Vorticella campanula is found living in crowded groups on pond weed. In an aquarium, the whole population of a group will leave their stalks almost simultaneously and become free-swimming. They do not disperse, but remain for an hour or two suspended from the weed in thread-like swarms. Fig. 1 is a photograph (half natural size) showing three such threads. One of the threads is seen to have a triple base: it arose by the fusion of three threads brought into contact by water movements. Each thread has a mucous core which is collectively secreted by the swarmers, each individual contributing its own mucous strand to the thread. The swarmers, after swimming actively for a time—some very close to the thread, some actually within it—finally settle down again in groups on solid objects.

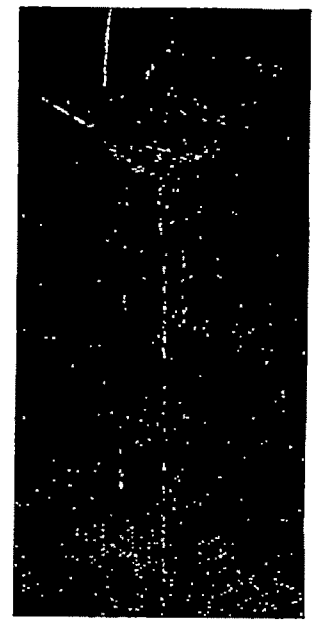

FIG 1.

We have observed this swarming many times, not only in *V. campanula*, but also in another gregarious form, *V. chlorostigma*. Usually, in the latter, the swimming animals collectively form a globular cloud, like a minute swarm of bees. Within this they appear to move quite freely; but the swarm as a whole can be dragged through the water with a needle; and it was demonstrated in other ways that in this species too the swarming individuals are united by mucus. The new sessile groups, formed by the settling of a swarm, sometimes swarmed again after twenty-four hours, and occasionally this was repeated on three or four successive days.

We cannot say what is the stimulus that causes *Vorticella* to swarm. Continuous observation, extending over the complete sessile and free-swimming cycle, proved that swarming is not, at any rate immediately, connected with asexual reproduction or with conjugation. Obviously such behaviour, in natural conditions, admirably subserves the dispersal and settlement in contiguity of a gregarious sessile protozoon.

A full account of these observations will be published in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.
H. G. NEWTH.
Department of Zoology,
University of Birmingham.
Aug. 2.

Puff and Profile Theory of the Vowels

THE portions of sound film tracks reproduced in Fig. 1 are from registrations of the vowels *oo* (as in *boo*), *ee* (as in *bee*), *ah* (as in *bah*), *ay* (as in *bay*), *æ* (from *a* in *an*). The registration in each case shows a series of contiguous short bits of vibration in each of which the movement begins strongly and fades rapidly to zero. Such a movement occurs only as a free vibration, that is, as the movement of a vibratory system disturbed in its equilibrium and then left to itself. A vibration of this kind is produced when the air in the vocal cavity is rarefied or condensed by snapping the thumb out of the mouth or by closing and suddenly opening the glottis. Such a sudden

rarefaction or condensation may be termed a *puff*. Repeated puffs will produce a series of free vibrations. To the eye, each bit of vibration in Fig. 1 has a special *profile*. The profiles of the same vowel are nearly, but not quite, alike; those of different vowels are different. The eye learns to recognise the profiles automatically just as it recognises the profiles and portraits of persons; it performs no analysis. No amount of mutilation by lines, blotches or omissions changes the vowel character of a profile. So long as anything can be recognised, it remains the profile of the same vowel; it never changes to the profile of another vowel.

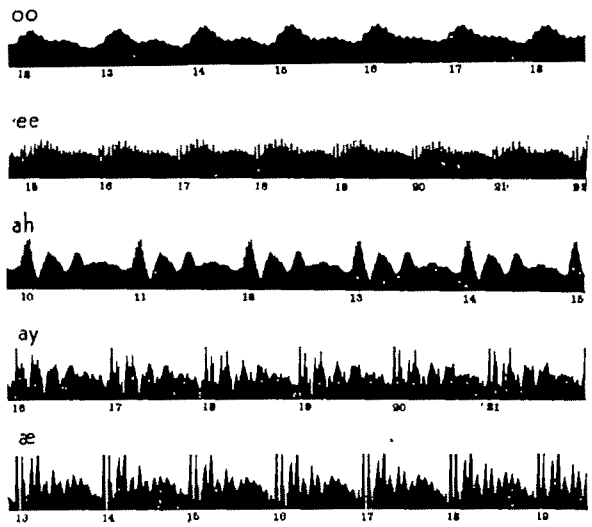

FIG. 1.

The sense of hearing recognises vowel vibrations as the same or different according to their sense impressions, that is, according to the likeness or difference of the profiles. There is no analysis. Experiments in filtering[1] show that any frequency or range of frequency can be removed from the vowel vibrations without changing the vowel character. So long as anything is left, the vowel remains the same one; it never changes to another vowel. The law of no change of speech character by mutilation is valid here also.

The puff and profile theory agrees with that of Willis-Helmholtz-Hermann in regard to the *production* of vowel vibrations by the action of glottal *puffs* on the air in the vocal cavity. It is opposed to it in asserting that the *perception* of vowel characters depends on the unanalysed *profiles* of the vibrations and not on any special frequencies or groups of frequencies.

E. W. SCRIPTURE.

Phonetic Laboratory,
62 Leytonstone Road,
London, E.15.

[1] See NATURE, 130, 275; 1932.

Magnetism of Copper

A LARGE amount of experimental evidence has been recently put forward to show that colloidalisation of certain metals is accompanied by large changes in their magnetic susceptibilities[1]. I suggested some preliminary ideas to the effect that the increased area of surface of the metal on colloidalisation might be responsible for the observed magnetic changes. Honda and Shimizu[2,3] have recently offered the more definite view that, in the case of tin, the lattice constant is somewhat larger at the surface layer than in the interior, and that consequently the paramagnetic component due to the free electrons decreases and the diamagnetic component due to the bound electrons increases, so that the colloidal powders become more diamagnetic than the massive metal. According to them, colloidalising a metal has the same effect as cold-working, so far as the magnetic properties are concerned.

Copper is a metal for which we have trustworthy magnetic measurements when cold-worked. Honda and Shimizu found that on reducing the density of the metal by cold-working, the diamagnetic susceptibility increased in value, after the necessary corrections were made for the presence of ferromagnetic impurities. A similar increase of the diamagnetic susceptibility was observed when metallic copper was colloidalised.

Colloidal copper was prepared by an electrical dispersion method[4], the dispersing medium being benzene or propyl alcohol. The dispersing and centrifuging experiments were conducted in the absence of air, and hence the possibility of chemical action modifying the results does not arise. It was found that the diamagnetic susceptibility (χ) of copper depended only on the dimensions of the particles and not on the nature of the dispersing medium. The magnetic measurements were made with a Curie balance, with water as the standard substance. Measurements were conducted at different field strengths to correct for the presence of ferromagnetic impurities.

The specific diamagnetic susceptibility of copper in bulk was found[5] to be 0·080 (all values of χ are given in 10^{-6} units). As the size of the powders decreased from 10 μ to 0·8 μ, the value of χ showed a small increase from 0·080 to 0·090. When, however, the diameter was reduced from 0·8 μ to 0·4 μ, the value of χ showed a relatively larger change, from 0·090 to 0·135. These results fully agree with conclusions of Honda and Shimizu.

It will also be noted that the critical diameter below which χ increases rapidly is 0·8 μ, which is much smaller than the corresponding values for graphite (1·5 μ)[5], bismuth (1·4 μ)[6] and tin (2·0 μ)[1]. Since copper has a face centred cubic lattice, we have no directional variations as in the case of graphite or bismuth. It appears, therefore, most likely that the observed changes of χ in the case of copper colloids are to be attributed to causes quite different in nature from those arising in the crystals just mentioned.

An approximate calculation shows that the surface layer wherein the density is less than the density inside the metal is of the order of a few hundred atomic layers.

Full details will be published shortly elsewhere.

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June 22.

[1] NATURE, 134, 288; 1934; *Proc. Ind. Acad. Sci.*, 1, 123; 1934
[2] NATURE, 135, 108; 1935.
[3] NATURE, 132, 565; 1933.
[4] Svedberg, "The Formation of Colloids", p. 28.
[5] *Ind. J. Phys.*, 6, 241; 1931.
[6] *Ind. J. Phys.*, 7, 35; 1932

Oxide Film of Alloys containing Small Percentages of Aluminium

WHEN copper alloys containing more than 2 per cent aluminium were heated for many hours at a red heat (800°–900° C), no oxide scales were formed. In cases where several per cent of this element was added, the alloys even retained their characteristic golden yellow lustre, which is a very remarkable fact. Elements such as tin, zinc, nickel, manganese, magnesium, iron, etc., when added to copper do not produce this effect.

The oxidised surfaces were studied by means of cathode ray reflection. Copper surfaces exposed at a red heat gave the CuO pattern. (At lower temperatures, the Cu_2O and a three ring pattern were also observed, as first pointed out by G. P. Thomson and C. A. Murison[1].)

Upon heating alloys containing several per cent of aluminium at a red heat with a Bunsen burner, the surface in contact with air was blackened and gave the CuO pattern, while the surface imbedded in the oxidising flame remained bright and gave a pattern corresponding to that of pure γ-Al_2O_3. No diminution of the lustre of the latter surface was observable after continued heating.

The fact that alloys, containing only about 10 atomic per cent of aluminium, when heated with an insufficient supply of oxygen, become covered with a film of pure Al_2O_3 seems rather striking; because some copper oxide was anticipated. In the case where heating was done in air or in oxygen, the uppermost surface probably becomes covered with an extremely thin film of copper oxide, but beneath this layer, since oxygen is wanting, an Al_2O_3 film might be formed, and this in turn probably protects the inner part from further oxidation. Inasmuch as such a film is colourless, the alloy does not loose its golden lustre, even after prolonged exposure to red heat. The same may be true of iron alloys.

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[1] G. P. Thomson, *Proc. Roy. Soc.*, A, 128, 649; 1930. C. A Murison, *Phil Mag.*, 17, 96; 1934.

Iridium Isotopes and their Nuclear Spin

AN examination of the hyperfine structure of the arc lines of iridium λλ3800·10, 3513·67 and 2924·81 A. radiated from a modified form of hollow cathode reveals that the three lines having a common lower level in the ground term $5d^86s\ ^4F_{4\frac{1}{2}}$[1] are identical in structure. The hyperfine components are therefore ascribed to a spin splitting of the ground term with the upper levels unsplit. λ3513·67 A. ($5d^86s\ ^4F_{4\frac{1}{2}}$ – $5d^86p\ ^4G^0_{4\frac{1}{2}}$) exhibits the following structure:

$d\nu$ in cm $^{-1}$	(Int.)	Remarks
+ 0 072	(7)	This component is diffuse and appears almost as a continuous patch between
0 000	(22)	+ 0 072 and 0 000, indicating the
− 0·073	(13)	presence of an expected satellite at
− 0·145	(9)	+ 0 033 (9) (vide Fig 1)

The observed structure is accounted for uniquely by assuming two isotopes of masses 191 and 193 with nuclear spins of $\frac{1}{2}$ and $\frac{3}{2}$ respectively. The ratio of the magnetic moments of the two nuclei is nearly −1·0. The isotope displacement in $5d^86s\ ^4F_{4\frac{1}{2}}$ is 0·057 cm.$^{-1}$, with the heavier isotope lying deeper, as in the arc lines of copper and thallium.[2] The incompletely resolved patterns of some other Ir I lines λλ3220·79, 2694·22, 2664·77 and 2639·70 A. support the above conclusions. The existence of isotope shift favours the suggestion that the ground term is a $^4F_{4\frac{1}{2}}$ term arising from an electron configuration $5s^25p^65d^86s$ in preference to a $^2D_{3/2}$ term from $5s^25p^65d^9$.[3]

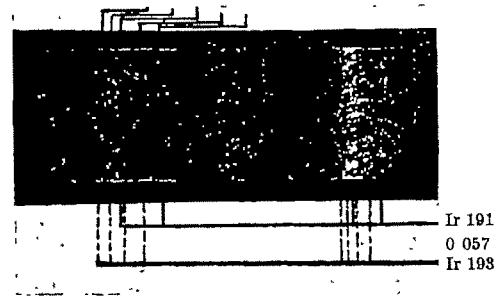

FIG 1. Structure pattern of Ir I, 3513 67 A obtained with a Hilger quartz Lummer plate, 3·45 mm thick, 20 cm. long.

Iridium is one of the few elements the isotopic constitution of which has not so far been revealed by the mass-spectrograph. Judging from a visual estimate of the intensities of the components, the relative abundance of the isotopes 191 and 193 is 1 : 2, giving a value, perhaps a little too low, of 192·4 for the atomic weight of iridium. It appears, however, that the atomic weight of the iridium must be less than 193; there is considerable disagreement in the values of atomic weight given by several investigators, which range from 192·59 to 193·40. The existence of a heavier isotope like 195 is ruled out by the fact that usually there is no isobare in appreciable quantity for an isotope of an element with odd atomic number; and platinum has been previously shown to contain the isotope Pt 195 to the extent of nearly 30 per cent.[4]

Details will appear in the *Proceedings of the Indian Academy of Sciences*.

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Aug. 7.

[1] Albertson, *Phys. Rev.*, 42, 443, 1932.
[2] Venkatesachar and Sibaiya, *Proc. Ind Acad. Sci*, 1, 13; 1934.
[3] Meggers and Laporte, *Phys. Rev*, 28, 660, 1926
[4] Venkatesachar and Sibaiya, NATURE, 136, 65: 1935. *Proc. Ind Acad. Sci.*, 1, 955, 1935. *ibid.*, 2, 101, 1935.

K-Series of Magnesium and Sodium

I HAVE already published[1] some results obtained in the region of long wave-lengths with the ionic tube designed and constructed by me with Prof. Dolejšek[2]. With this ionic tube and with a new focusing method, the principle of which will be described elsewhere, I have obtained some new results which show the great efficacy of our apparatus for long wave-lengths of X-spectra.

As an example of what can be obtained by our

ionic tube, I should like to point out in this connexion that with the ionic tube alone, using the normal Bragg method, I obtained the new non-diagram lines in the K-series of Mg and Al which were recently found by Prof. M. Siegbahn and H. Karlsson[3] using new focusing methods, which they have worked out. By our new focusing method and with this ionic tube I have obtained in the spectrum of Mg all these lines, and especially when nitrogen is let into this tube, I have further got, as can be

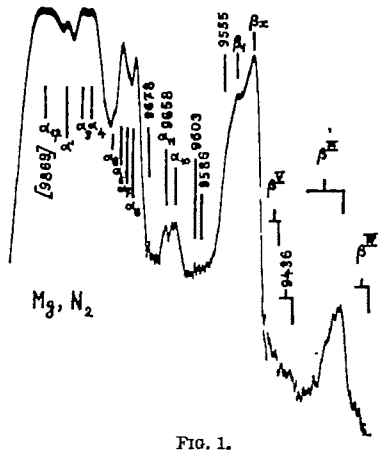

FIG. 1.

seen from the microphotometric curve (Fig. 1), the lines in the α-group as well as those in the β-group, which have not hitherto been observed.

In the emission spectrum of MgO, when oxygen is let into our ionic tube, there are certain changes; for example, in the α-group the lines 9603 and 9586 X. do not occur and $\alpha_{10,11}$ appear as a single broad band, and changes analogous to these also occur in the lines of β-group. I have found similar characteristic qualities in the spectrum of sodium

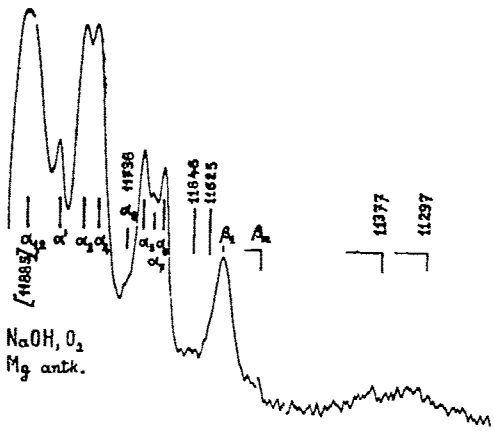

FIG. 2.

oxide. The microphotometrical curve of the spectrum of sodium (NaOH on the magnesium anticathode) is reproduced in Fig. 2. In these curves the lines which were hitherto neither known nor measured are indicated with their wave-lengths.

Both spectra were obtained using an effective tension of 2,000 v. and 200 ma. in the case of Mg, and 1,500 v. and 200 ma. in the case of Na, thus avoiding the occurrence of lines of higher orders.

As in the above investigation on the emission spectra of the K-series, I have tried to find the white absorption lines, which I have obtained while studying the M-series with the ionic tube and without the use of the focusing method. In the place where I formerly found two white lines and classified them as M_{II} absorption of Ta, I have now got these white lines and also obtained a complicated structure. But this absorption effect, classified by me as M_{II} absorption of Ta[4], must be classified as the absorption structure of sulphur from the crystal, which has not been observed until now. In the place where I formerly obtained the white line and classified it as M_I absorption of W, I have now again got the same line, and at present from our results it is not possible to find any other classification for it. It is necessary, however, to reinvestigate this identification since the results for both elements do not agree. This will be possible after obtaining more experimental data.

The examples mentioned of the results in the K-series and the absorption of sulphur show that our ionic tube, in connexion with any focusing method, gives further possibilities in the region of long wave-lengths.

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[1] V. Kunzl, NATURE, 132, 139, 1933. *Acta Phys. Polonica*, 2, 447; 1934.
[2] V. Dolejšek and V. Kunzl, *Z. Phys.*, 74, 565; 1932.
[3] M. Siegbahn and H. Karlsson, NATURE, 132, 895; 1933. *Z. Phys.*, 88, 76; 1934.
[4] V. Kunzl, l.c.

Action of Benzylcarbonyl Chloride on Insulin and Other Proteins

IN previous investigations, the reaction between phenyl *iso*cyanate and proteins has been used to study the immunological properties of protein antigens[1]. In other investigations[2], it was found that insulin is readily inactivated by phenyl- and *p*-bromophenyl *iso*cyanates, and from the information derived from the earlier work, the conclusion was reached that this inactivation is due to a reaction between the *iso*cyanate and the free amino-groups of the insulin. Jensen and Evans simultaneously investigated this inactivation of insulin[3], and reached somewhat similar conclusions.

Recently, we have been studying the action on proteins of benzylcarbonyl chloride ($C_6H_5.CH_2.O.CO.Cl$), the reagent used with such success by Bergmann and his co-workers[4]. These chemical and immunological investigations are not yet complete, but sufficient evidence is available to show that this reagent reacts quite readily with native proteins, just as it does with the free amino-groups of amino-acids and simple peptides. This reaction, like that between phenyl *iso*cyanate and proteins, is quite mild, and proceeds smoothly at about *p*H 8 and 5° C. As the reaction continues, there is a marked diminution in the free amino-nitrogen of the protein, and in many cases, the product (benzylcarbonato-protein) contains practically no free amino-nitrogen. On injection into rabbits, the benzylcarbonato derivative of serum globulin produces antibodies which, from precipitin and inhibition tests, appear to be specific for the new grouping in the protein (the benzylcarbonato-amino acid group).

In the course of chemical and immunological investigations on insulin, the physiological activity of benzylcarbonato-insulin has been studied, and it has been found that this derivative has no significant

hypoglycæmic power. Benzylcarbonyl chloride readily inactivates insulin, probably just as rapidly as does phenyl *iso*cyanate, and in this inactivation also it seems probable that the loss of hypoglycæmic power by the insulin is due to the blocking of the free amino-groups. This appears to offer additional support for the view that the active groups of insulin contain free amino-groups, and that the latter are essential for the activity of the insulin (cf. Jensen[5]). Attempts are now being made to activate these inactive insulin derivatives.

The amount of benzylcarbonyl chloride required to inactivate insulin is very small, and 100 mgm. of insulin of potency 19,500 units per gm. (kindly supplied by Messrs. Boots Pure Drug Co., Ltd.), can be completely inactivated by 150 mgm. of this reagent. The minimum amount of benzylcarbonyl chloride needed to react with all the free amino-groups of insulin, calculated on the basis that insulin contains 1·0 per cent of free amino-nitrogen[6], is approximately 12 mgm. per 100 mgm. of insulin. This smaller amount of acid chloride causes partial loss of hypoglycæmic activity only, possibly because some of the reagent may be destroyed by the water present. It is possible, however, that the reaction with benzylcarbonyl chloride is not confined to the free amino-groups of the insulin, and further investigations are being made to decide this point.

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[1] Hopkins, S. J., and Wormall, A., *Biochem. J.*, **27**, 740 and 1706, 1933. **28**, 228; 1934.
[2] Hopkins, S. J., and Wormall, A., NATURE, **134**, 290; 1934. *Biochem. J.*, **28**, 2125; 1934.
[3] Jensen, H., and Evans, E. A., *J. Biol Chem.*, **108**, 1; 1935. *cf.* also, *Physiol. Rev.*, **14**, 188; 1934.
[4] Bergmann, M., and Zervas, L., *Ber.*, **65**, 1192; 1932. *cf.* Bergmann, NATURE, **131**, 662 and 698; 1933.
[5] Jensen, H., *Science*, **75**, 614; 1932.
[6] Freudenberg, K., Dirscherl, W., and Eyer, H., *Z. physiol. Chem.*, **202**, 128; 1931.

Points from Foregoing Letters

SIR JAMES JEANS compares the observed eccentricity of the orbital motions of binary stars with that calculated from the principle of equipartition of energy. He points out that there is a good agreement between the calculated and observed figures, which supports the long time scale (10^{13} years) for the life of the universe.

To explain certain observations on blood group inheritance, Ffoulkes Edwards and Etherington have suggested the existence of a fourth hereditary unit (allelomorphic gene). Prof. J. B. S. Haldane points out, as one alternative explanation, that in some individuals the three known allelomorphs may be carried by three chromosomes, instead of by two, and he suggests ways of testing this hypothesis of 'trisomy'.

Prof. V. F. Lenzen offers a few remarks on the philosophical basis of science upon which, he hopes, all philosophers of science can agree.

Mr. A. E. Needham shows that Weldon's case of change of proportions in the growth of young shore crabs is due to heterogonic growth in the individual, and is not a mere average effect produced by natural selection.

The incidence of rickets in a new strain of 'rex-coated' rabbits (with mole-like fur) is described by W. King Wilson. Attempts to prove the recessive nature of the disease by mating individuals suffering from rickets were unsuccessful.

Vitamin C (ascorbic acid), in concentrations of 1 to 5 parts in 10,000, is found by László Havas to accelerate the growth and increase the length of the shoots of germinating wheat.

Prof. H. Munro Fox and Mr. H. G. Newth describe the swarming behaviour of two common species of gregarious vorticellids. All the individuals in a group become free-swimming simultaneously and form a swarm which is held together by mucous threads secreted by the swarmers. When the latter again settle down, they do so in close contiguity owing to their mucous attachments.

Prof. E. W. Scripture submits reproductions of sound-film tracks for various vowels. He points out that they support the 'puff and profile' theory, according to which vowel vibrations are produced by the action of glottal puffs on the air in the vocal cavity, and the perception of vowel characters depends on the unanalysed profiles of the vibrations.

Prof. S. Ramachandra Rao finds that the diamagnetic susceptibility of colloidal copper is greater than the value for the massive metal. The critical diameter of particles below which the susceptibility shows a rapid increase is 0·8 μ. The results support the conclusions of Honda and Shimizu that colloidalisation has the same effect as cold-working so far as the magnetic properties are concerned.

The protective effect of aluminium upon the oxidation of copper at red heat is described by I. Iitaka and S. Miyake, who have studied the oxidised surfaces by means of cathode ray reflection. Copper alloys containing more than 2 per cent of aluminium can be heated to a red heat for several hours without forming oxide scales. An alloy containing about 10 per cent, when heated with an insufficient supply of oxygen, becomes covered with a thin film of oxide.

From the hyperfine structure of certain lines of the arc spectrum of iridium—the only element the isotopes of which have not hitherto been identified—Prof. B. Venkatesachar and L. Sibaiya infer the existence of two isotopes of masses 191 and 193 with nuclear spins of $\frac{1}{2}$ and 3/2 respectively. A rough estimate of the relative abundance of the two isotopes is 1 : 2, which in the absence of a higher isotope would lead to an atomic weight of less than 193 for iridium.

By means of the ionic tube designed by Kunzl and Dolejšek, for the detection of the longer X-ray waves and with a new focusing method, Dr. V. Kunzl has observed several new lines in the X-ray spectra of magnesium and sodium. He now ascribes to sulphur certain 'white lines' previously classified as due to the absorption spectrum of tantalum.

The observation that Bergmann's reagent (benzylcarbonyl chloride) inactivates insulin is considered by W. E. Gaunt, G. Higgins and Dr. A. Wormall as additional support for the view that the free amino-groups of insulin are essential to that compound's power of reducing the sugar content of the blood.

Research Items

Glazed Stones

In continued study of glazed stones, Mr. H. L. Beck deals with glazed quartz and carnelian, agate and felspar (*Ancient Egypt and the East*, Pt. 1, 1935). In the glazing of quartz (including quartzite and chert), great care has to be taken to prevent flawing of the quartz base. The glazing of quartz was practised in Egypt from Predynastic times to the eighteenth dynasty. In Mesopotamia, beads are found at different dates in two varieties, *high polish* and *frosted*, so called on account of the present surface. Some at Ur are dated from before 3500 B.C., though some of A.D. 900 are identical. Beads are also found in Persia and Syria. Three of the high polish variety were found at Mohenjo-daro, one, a lenticular cylinder, being of a shape not recorded in either Mesopotamia or Egypt. A number of specimens of glazed quartz have been found in northern India, which are dated at the first century A.D. No specimens are reported from Europe; and the process is not practised to-day. The great majority of specimens of glazed quartz from Egypt are beads. In India there is a number of small but elaborately worked pendants representing animals. In Egypt a soda glaze coloured was applied to the bead and then fused. The Mesopotamian coloured beads were hammered to cover them with conchoidal fractures before glazing. In the high polish beads the surface is altered by an alkali. It is possible that all types were coloured. The most important other stones chemically treated were carnelian, agates and chalcedonies. They were not actually glazed, but received a special treatment in which soda was added, usually as a decoration. Many carnelian beads have a white patination; but it is difficult to say whether it has been purposely applied or is due to action of the soil.

Kmer Art and the Cultures of Precolumbian America

M. Henri Marchal offers (*J. Soc. Américanistes*, N.S., 26, 2) a tentative explanation of certain remarkable features in Kmer art, which appear out of harmony with its Indian origin and its relation through the art of India with that of ancient Egypt, Greece and the Mediterranean. These incongruous elements are to be attributed to the Polynesian influences which have been discerned in the art of Java and Bali, and also in America. As an example may be taken the monstrous heads, known in Cambodia as *Rahu*, which with the *naga* form one of the dominant motifs in Kmer art. The characteristic lineaments appear nowhere in occidental art (except in the head of Medusa and its derivatives) but are to be found in the Mayan art of America, especially in the heads placed over the openings into buildings, for example, at Palenque, exactly as they are used in Cambodia and Java. They are to be found also on Toltec pottery, where the god Tlaloc is represented without lower jaw. This motif is scattered widely over Polynesia, appearing in Maori art, especially in the carved wooden lintels and gables of New Zealand, and the tattoo-markings and petroglyphs of the Marquesas. The head with flanking forearms or claws of America does not appear in Polynesia, but is present in China. Superimposed heads forming balusters before the entrance to Kmer temples may be compared with sculptured figures of Piedras Negras in Central America. A striking resemblance which has impressed everyone who has visited both localities is to be found in the general profile of the *teocallis* or pyramidal mounds of America and the *prasat* of Cambodia. Step pyramids surmounted by sanctuaries in Mayan architecture find their analogies in Kmer temples such as Phimānakas, Bakon and above all the Pran of Kohker. Among other resemblances in construction are the introduction of a wooden beam in masonry work, the projecting stone which is carved, the use of the serpent for decorative purposes, and the employment of the corbelled arch.

Fishes from the Philippine Islands

The *Philippine Journal of Science*, 55, No. 3, 1934, contains three papers on fishes: (1) "The Philippine Phallostethidae, a Description of a New Species, and a Report on the Biology of *Gulaphallus mirabilis*, Herre" by D. V. Villadolid and P. R. Manacop; (2) "Philippine Sillaginidae" by M. C. and H. R. Montalban; and (3) a long systematic paper on Philippine Isospondylous fishes by A. H. Roxas. The Philippine Phallostethidae comprise a very interesting group of fishes, unique in having a peculiar sexual organ in the male, named the priapium by Tate Regan, who first discovered it in 1913. The pelvic fins are vestigial in the female and absent in the male, the latter having below the head and throat this priapium containing the coiled vas deferens and the end of the intestine, together with a complicated skeletal system consisting of two long curved bones, proved in the present paper to be used as a clasping organ. The eggs are probably fertilised as they pass through the oviduct, and when laid are provided with adhesive thread-like processes with which they attach themselves to weeds. These filaments seem to suggest that the genus is more closely related to Percesoces than to the Cyprinodontes where they are usually placed. Spawning appears to continue throughout the year. Interesting notes on food and feeding habits are added, *Gulaphallus* having a mixed diet both in young and adult consisting of vegetable matter which is less as the animal grows, insects, especially chironomid larvæ and pupæ, which rank first in importance, small crustacea and even the larvæ of its own species, eaten by both young and old but only in January when the breeding season is at its height. The development of *Gulaphallus mirabilis* is described from the newly hatched egg to the time when the priapium is fully formed—in about 19–20 weeks after hatching.

Germ-Cell Cycle in the Hessian Fly

Margot E. Metcalfe (*Quart. J. Micr. Sci.*, 77, Pt. IV; 1935) has investigated the germ-cell cycle in the Hessian fly, *Phytophaga destructor*. The somatic cells in both sexes contain four pairs of V-shaped chromosomes. The germ-cells in both sexes contain eight pairs of chromosomes. In the maturation of the egg, eight bivalents are formed, which divide but remain in anaphase until the time of fertilisation.

The polar bodies are then formed, but are never extruded from the egg; they migrate to the surface of the egg, divide irregularly and eventually degenerate. The female pronucleus has eight chromosomes. In spermatogenesis, reduction is effected in a peculiar manner. In the first spermatocyte the chromosomes separate into two groups, of twelve and four respectively, and the four pass into a process of the cell which separates as a small cell. After a short period of rest, the spermatocyte again divides unequally, the resulting spermatid having eight chromosomes and the second bud four chromosomes. Thus each spermatocyte gives rise to one sperm only. The germ-line (that is, the germ-cell nucleus). is differentiated after the third cleavage, that is, in the eight-cell stage. At the fourth cleavage the germ-cell nucleus divides synchronously with the somatic nuclei; there are sixteen nuclei each with sixteen chromosomes. At the fifth cleavage the somatic nuclei eliminate eight chromosomes and are left with eight chromosomes.

Hystricoid Rodents of the Neotropical Region

A VALUABLE, if necessarily dull, account of the taxonomy of these rodents has appeared (*Bull. Amer. Mus. Nat. Hist.*, 68, Art. 5; 1935). The author, G. H. H. Tate, gives fully for each genus its pre-Linnean and post-Linnean taxonomic history, discusses special points of difficulty, indicates the genotypes, and gives a list of all the named forms, specific and sub-specific, with their type localities.

New Garden Alpine Plants

NUMEROUS expeditions to Persia, Tibet, Burma, the Andes and other places have recently been organised for the purpose of collecting new plants for the enhancement of garden beauty. The names of Farrer, Kingdon Ward, Giuseppi, Comber, Ball and others are well known among gardeners for their activities in botanical exploration, and modern gardens owe much of their interest to them. An article by Dr. H. R. Smith on "New Alpines" (*J. Roy. Hort. Soc.*, 60, Part 6, pp. 246–255, June, 1935) enumerates an imposing list of plants for the rock garden which have been introduced during the last five years as a result of such botanical exploration. Lilies and rhododendrons are not treated, but more than sixty species belonging to other genera are described. Campanulas, primulas, gentians and narcissi are well represented, and brief accounts of the circumstances of their introduction are given.

Life-Histories of British Pyrenomycetes

MR. C. G. C. CHESTERS has commenced a series of studies on British Pyrenomycetes. The whole life-histories of most members of this division of the fungi are not known, and many phases probably lie buried among the taxonomic labyrinths of the Fungi Imperfecti. Pure culture methods are used in the investigation, and the first part of the work is devoted to "The Life-Histories of Three Species of Cephalotheca" (*Trans. Brit. Mycol. Soc.*, 19, Part 4, June 1935). The three species which have been recognised are *C. sulfurea*, *C. purpurea* and *C. reniformis*. These are described in minute detail, and characters of the genus are also given. Extensive lists of synonyms appear, and the mass of detail portrayed in the paper crystallised into a very simple determinative key at the end.

The Formosa and Quetta Earthquakes

A PRELIMINARY report on the Formosa earthquake of April 21, by Mr. R. Takahasi, is published in the *Proceedings of the Tokyo Imperial Academy* (11, 224–226; 1935). The number of lives lost was 3,276, and that of the houses completely destroyed 121,398, this great number being due to the poor construction of the houses. Displacements occurred along several faults during the earthquake. Along one, more than six miles in length, the horizontal and vertical displacements were respectively 6 in. and 2 in. Along another, a thrust fault of about the same length, the horizontal movement was slight, but the vertical shift amounted to 10–12 in. The epicentre lay in about lat. 24° 22′ N., long. 120° 48′ E., or between the two above faults. The detailed report will appear later in a special volume of the *Bulletin of the Earthquake Research Institute*. In a paper in *Science and Culture* (1, 71–72; 1935), Messrs. S. N. Sen and R. Bakshi determine the epicentre of the Quetta earthquake of May 31 as in about lat. 30½° N., long. 66½° E., or along the Khojak Range just to the south of Chaman and about sixty miles north-west of Quetta. Thus, the origin of the recent earthquake coincides closely with that of the severe earthquake of December 20, 1892, caused by a large displacement along the boundary fault which has been traced for a distance of 120 miles.

Thermodynamical Relations

PART No. 740 of vol. 234 of the *Philosophical Transactions of the Royal Society*, A, is devoted to a communication by Prof. A. Norman Shaw of McGill University on "The Derivation of Thermodynamical Relations for a Simple System". The aim of the author is to outline a systematic procedure for effecting transformations of thermodynamical formulæ which involve quantities not directly determined by experiment or determined with low accuracy, in order to replace them by quantities directly observed or determined with higher accuracy. The method adopted is that of converting any thermodynamical equation involving the usual quantities p, v, T, S, E, I, F and G and their derivatives with respect to each other into an equation connecting Jacobians of the partial derivatives of two quantities x and y with respect to two independent variables α, β by assigning to x, y, α, β values identical with any number up to four of the above thermodynamical quantities. Thus the thermodynamical equation $dE = TdS - pdv$ is converted into $J(xE) = TJ(xS) - pJ(xv)$ where J is the symbol for Jacobian and x and the independent variables α and β are undetermined. Once the equations are in Jacobian form the laws of transformation of Jacobians can be utilised to effect the thermodynamical transformations required. To facilitate the work four tables are given in which x, y, α, β are assigned values p, v, T, etc., and the resulting Jacobian expression tabulated in terms of five of the simplest Jacobians. Instructions for the use of the tables and worked examples are given as well as 35 equations useful in manipulations of J functions.

The Electronic Oscillator

CONSIDERABLE research has been carried out recently on the generation of electrical oscillations corresponding to wave-lengths of 10–100 cm., by means of the valve circuit arrangements first demonstrated by Barkhausen and Kurz. The

theoretical study of this subject has resulted in the publication of much complicated analytical work, the physical principles of which have at times been somewhat difficult to visualise. The author of some of this theoretical treatment, Mr. F. B. Llewellyn, has presented a simple statement of these principles in plain language in an article entitled "The Barkhausen Oscillator" published in the August issue of the *Bell Laboratories Record*. The case considered is that of a simple triode valve operating with a positive grid potential; and the oscillating motion of individual electrons between cathode and anode through the spaces of the grid is dealt with. The difference in motion of these electrons due to the static forces alone and with the superimposition of the alternating forces due to the potential difference across the external tuned circuit is explained and illustrated graphically. The maintenance of oscillations is shown to be due to the non-symmetrical motion about the grid of those electrons which are correctly phased relatively to the alternating forces, and the consequent transfer of some of their energy into the external tuned circuit. The tuning of this circuit can modify the frequency of the oscillations by about thirty per cent, but for fixed supply voltages of the valve electrodes, there is a particular tuning adjustment which gives maximum output.

Platinum Electrode in Solutions of Foreign Ions

MR. I. ORESTOV, of the Middle Asiatic State University, Tashkent, informs us that he has studied the behaviour of a platinum wire electrode in a series of solutions of potassium sulphate of normalities 0·5005, 0·1001, 0·0500 and 0·0100, with a salt bridge and saturated calomel electrode:

$$Pt|K_2SO_4(c)|KNO_3(sat.)|KCl(sat.)|Hg_2Cl_2|Hg$$

and very variable potentials were found. When, however, a stream of pure nitrogen was passed through the left-hand half element, a reading taken after 90 minutes showed that all four electrodes had on the average the same potential of $0{\cdot}2336 \pm 0{\cdot}0010$ volt. Observations with one electrode (N K_2SO_4) at 23·1° were then made every minute and 90 readings obtained. These were arranged in a statistical row which was found to correspond very closely with the natural theoretical row, the standard deviation σ being $\pm 2{\cdot}35$ mv., the index of closeness of fit (Pearson) being $\Delta = \pm 2{\cdot}33$, the asymmetry number S being $+ 0{\cdot}23$, and the excess $Ex = + 0{\cdot}2$. The source of the fluctuations, following a suggestion of Posner, is regarded as the fluctuations of ions in a Helmholtz double layer on the electrode. Further observations are in progress, when the theory of fluctuations (Smoluchovsky-Svedberg) will be applied to the results.

Probability and Frequency

A SATISFACTORY basis for the theory of probability has not yet been found. The weakness of the 'equally-likely' definition is well known, but the 'statistical' or 'relative frequency' definition, favoured by Chrystal and others, is also open to objection. An interesting discussion of some of the fundamental difficulties has been given recently by F. P. Cantelli (*Ann. l'Institut Henri Poincaré*, 5, 3; 1935). If a symmetrical coin, equally likely to turn up head or tail, is tossed a large number of times, it is not certain that the proportion of heads will be exactly $\frac{1}{2}$. What is more, it is not even certain that the proportion will approach $\frac{1}{2}$ as a limit; for if it were, to any number ε, however small, there would correspond a number N such that for every set of N or more tosses the proportion of heads would *never* differ from $\frac{1}{2}$ by more than ε. But this is not true; long runs of heads or of tails are not impossible, a fact which is awkward for mathematicians as well as for gamblers. The statement of the approach to the limit must be weakened, with *never* replaced by *scarcely ever*. The principal object of Cantelli's work is to express this replacement in precise mathematical terms drawn from the theory of aggregates.

Molecular Weights by the Ultra-Centrifuge

THE most satisfactory method for the determination of the molecular weights of macromolecules is by means of sedimentation equilibrium in the Svedberg ultra-centrifuge. The equations can be developed by thermodynamics, so that for sufficiently dilute solutions the shape of the molecule is not involved. In the case of material containing molecules of different sizes, average molecular weights are obtained. It is then necessary, for purposes of comparison with values found by other methods, such as viscosity determinations, as used by Staudinger, to have properly defined averages, and W. D. Lansing and E. O. Kraemer (*J. Amer. Chem. Soc.*, 57, 1369; 1935) have distinguished three such averages. The first, the number average, M_n, corresponds with osmotic methods involving counting of the molecules; the second, the weight average, M_w, corresponds with Staudinger's method, and a third, the so-called 'Z-average' molecular weight, M_z, is obtained from centrifuge data. The concentration of a solution subjected to a centrifugal or gravitational field is such that the concentration gradient at equilibrium ensures that at every point the chemical potential is equal but opposite in sign to the gravitational potential. Equations can then be set up giving the molecular weight from the experimentally observed concentration gradient. If this value varies with the distance along the cell, the material is assumed to be non-homogeneous. The authors enter into a detailed discussion of the calculation of the average molecular weights and apply the results to experiments on gelatin. The equations enable a correct comparison to be made between results obtained by different methods, thus avoiding a good deal of confusion which has hitherto resulted in this field.

Distance of Nova Herculis

THE majority of novæ are so far away that accurate measurements of their distances are very difficult to obtain. Trigonometrical parallaxes are too small to be trustworthy, and the best method so far depends on the rate of expansion (when available) of the surrounding nebular disc. An entirely independent method is now possible through the relation between distance and interstellar calcium absorption. This has been used in the case of Nova Herculis by E. G. Williams (*Monthly Notices, R.A.S.*, 95, 573), who has measured the intensity of the interstellar [K] line on twenty-four plates taken at Cambridge. The large displacements of lines due to the Nova itself, together with the absence of lines which might blend with the interstellar line, make these measurements comparatively simple. They yield a distance of 370 parsecs for Nova Herculis, corresponding to an absolute magnitude at maximum of $- 6{\cdot}5$ and a pre-outburst magnitude of about $+ 6{\cdot}7$.

International Society of Leather Trades' Chemists

THE bi-annual Conference of the International Society of Leather Trades' Chemists was held at the Institut des Arts et Métiers, Brussels, on September 1–6, jointly with the bi-annual meeting of the German sister society, the Internationalen Vereins der Leder Industrie Chemiker. Owing to the national mourning for Queen Astrid, some of the social functions in connexion with the Conference were cancelled. The meeting, however, was pronounced as one of the most successful yet held.

The Conference proper opened on Monday, September 2, under the chairmanship of M. G. Colchen (president of the Belgian Section, I.S.L.T.C.), assisted by Mr. Van Gijn (president of the I.V.L.I.C.) and M. C. R. Loos (president of the I.S.L.T.C.).

The Executive of the I.S.L.T.C. for 1936–37 was elected as follows: *President*, M. G. Colchen (Belgium); *Vice-Presidents*, M. C. R. Loos (France) and W. R. Atkin (University, Leeds); *Treasurer*, Prof. D. McCandlish (University, Leeds); *Hon. Gen. Secretary*, Dr. J. Gordon Parker (London); *Members of Committee*, Dr. P. Chambard (France), Dr. A. Gansser (Italy), M. R. Paniker (Spain) and L. Masner (Czechoslovakia). It was decided to hold the 1937 conference at Copenhagen. Dr. J. Gordon Parker was elected an honorary member of the Society in appreciation of the enormous amount of work he has devoted to its welfare. The official methods of analysis of the Society are to be published in book form, and it is hoped to have the publication ready by the end of the year.

Kubelka, Weinberger and Heger showed that acid rotting of vegetable tanned leather can be detected by extracting the sample first with water and then with 1 per cent caustic soda solution, and determining the nitrogen in the extracts, rotting being indicated by unusually high amounts of soluble nitrogen. Kubelka and Nemec demonstrated that the deposition of tannin sludge from a liquor depends upon concentration, the sludge increasing with concentration up to a maximum, and then on further concentration decreasing in quantity. In discussing the effect of metallic iron on vegetable tanned leather, Kubelka, Nemec and Zuravlev stated that the presence of unsaturated and oxy fatty acids in oils used for dressing resulted in a greater uptake of iron than with saturated acids such as stearic acid or neutral greases such as paraffin wax.

Dr. D. Jordan Lloyd discussed the modern theories of tanning, stating that X-ray examinations of collagen and of good quality and poor quality sole leathers show that tanning occurs at the active centres of the side chains of the collagen molecules and influences the side chain spaces of the bundles of parallel molecules that go to build up the collagen fibril (or fibre). If the tanning processes weaken or affect the collateral forces directly binding the backbones of the bundles of collagen molecules, or the longitudinal forces down the backbones of the molecules, the leather is of poor quality. All these inter- and intra-molecular forces can of course be affected by the pre-tanning processes, such as those which have been used for curing and in beamhouse work.

The influence of the hydrogen ion concentration of suspender tanning liquors on the fixation of tannin was the subject of a paper by G. Rezabek. He showed that at *p*H 4, hide powder fixes about one sixth to one quarter more tannin than at the natural *p*H of the liquors, namely 5 or 6. Tannage in alkaline medium, that is, at *p*H 8, gives approximately the same tannin fixation as in the non-adjusted liquors. The value of the microscope was illustrated by Dr. R. H. Marriott, who emphasised the value of an understanding of the fibre structure of leathers when assessing their value. Apart from its use in examining finished leather, microscopical examination is of the utmost value in detecting faults in the early manufacturing processes.

Dr. A. Jamet described a method for the estimation of formic acid in lactic acid based on distillation in the presence of a definite amount of lactic acid, whereby the formic acid can be recovered almost quantitatively. Dr. V. Casaburi and Dr. E. Simoncini discussed tanning by means of tungsten salts, particularly those of a more complex type. These tungsten compounds also act as excellent mordants for dyeing. A study on the action of nitrous acid on collagen, and the properties of the de-aminated collagen, was presented by Prof. L. Meunier and Dr. E. Schweikert. An excess of nitrous acid results in a true tanning effect, particularly if followed by treatment with sodium bisulphite. Further, at the iso-electric point of collagen, sodium nitrite alone has a marked tanning effect on collagen. The action of acids and basic dyestuffs towards deaminated collagen were described in some detail. Prof. C. Otin and G. Alexa gave an account of their work on the fixation of vegetable tannins by pre-chromed hide powder, indicating that the amount of vegetable tannin fixed depends upon the quantity of chromium present, also on the particular vegetable tannin used.

Some work on the accuracy of the glass electrode in alkaline solutions was discussed by Dr. D. Burton and J. Bateson. Prof. L. Meunier with A. Abbassi showed that a sulphur tannage takes place when pelt is treated with an acid pickle (salt and sulphuric acid) followed by a sodium thiosulphate bath. A very practical paper was that by L. Houben, who demonstrated the important part played by the stuffing grease mixture on the efficiency of leather belting. Prof. L. Meunier with P. Audrey described a method for preparing a uniform ossein from bones, and showed that this can be used as a substitute for hide powder in the determination of tannin in vegetable tanning materials. The estimation of methoxy (in the form methyl alcohol) in vegetable tannin extracts is the basis of a method for determining the presence of sulphite cellulose described by C. van der Hoeven.

In a paper on the theory of leather dyeing, Dr. G. Otto suggested that in dyeing with anionic reacting dyestuffs, the reaction of the principal valencies is more or less influenced by auxiliary valencies. Dr. F. Stather described experiments he has made on the relative rates of diffusion of vegetable tannins into pelt. Dr. Pollak gave details of his method for determining pyrogallol tannins in the presence of catechol tannin, the latter being precipitated by formaldehyde and hydrochloric acid (Stiasny), and then the former by urea. Sulphite cellulose extract

formed the subject of a paper by Dr. Kuntzel, who showed that this material is taken up by the basic groups of the hide substance molecule, and acts generally like the synthetic tannins.

A conclusion arrived at in a paper by Dr. E. Elod on the dyeing of leather is that if a series of acid or direct dyes be arranged in order of their dissociation constants, such order represents also their relative fastness to washing. The importance of drying in leather manufacture was discussed by Dr. K. Wolf, who mentioned that drying occurs in two stages, first the evaporation of the loosely held water, and secondly the loss of bound water, this latter being governed by the type of tannage and degree of tannage of the leather. Dr. W. Grassmann dealt with the chromatographic adsorption analysis of tanning materials. This depends on passing the solution through a tube of an adsorbent material (silica gel, kaolin, etc.) when a characteristic separation occurs, the strongly adsorbed constituents being retained in the upper layers while other constituents infiltrate to various depths. The preparation of sulphite cellulose extracts was discussed by L. Masner and V. Samec, and Dr. W. Hausam described certain pin hole defects in calf and goatskin.

Prof. Leplat gave an interesting lecture on the need for closer co-operation between the histologist and leather technologist, and showed how the newer science of histo-chemistry has been able to differentiate structural differences between tendon fibre and skin substance, which may account for their different behaviour on acid swelling.

Higher Agricultural Education in Great Britain

THE Report of the Departmental Committee on the Reassessment of Annual Grants to Institutions providing Higher Agricultural (excluding Veterinary) Education in England and Wales, 1934, is regarded by the Minister of Agriculture as of such importance that the non-confidential portions have been reproduced in full in the *Journal of the Ministry of Agriculture* of August 1935. It is understood, however, that some of the recommendations have already been implemented.

The fifteen institutions concerned, comprising agricultural colleges and university departments of agriculture, were visited by members of the Committee, and all available information as to work and finances considered in detail. The Committee lays great stress on the importance of education and research for the development of agriculture, quoting many specific instances where the results of research have materially altered the methods of agricultural practice. The importance of the agricultural colleges lies in the fact that experience shows that the farmers who are the first to introduce improved methods on their own farms and, indirectly, to their neighbours, are those who have received training at a college or farm institute. Any attempt to reorganise the agricultural industry in Great Britain must, therefore, ensure that the agricultural colleges are on such a footing that they can perform their functions with efficiency.

The attitude of the Committee was sympathetic and liberal, the object being to make such recommendations as would ensure the financial stability of each institution, without countenancing any waste or unnecessary expenditure of public money. At the same time, it was agreed that it is a mistake to penalise an institution that is successful, and that one that is so well managed that it pays its way should not on that account alone suffer a reduction in its grant. The financial crisis of 1931 prevented any increases in grants, and caused reductions in many cases, and as lowered incomes from this and other sources mean reduced expenditure, the position of the colleges in 1934 was one of stagnation due to lack of funds, rendering them unable to play their full part in the leadership of the agricultural industry.

Most of the colleges work in direct relation to the surrounding county areas; but the amount of local financial support varies considerably, both as regards direct grants and the award of scholarships, and in some cases this support is far from adequate. An increase in both types of financial aid from certain counties is very desirable, together with a greater co-operation for making the facilities provided by the colleges more widely known.

In most cases the existing staff is adequate to meet present demands, but the level of the salaries paid leaves much to be desired. This, added to the salary cut imposed in 1931, has resulted in deplorable conditions in certain specified colleges, and recommendations have been made for extra grants to improve conditions.

One result of the 1931 depression has been a fall in the number of fee-paying students, with a certain increase in scholarship holders, and in some cases the quality of the students is less good than formerly. It is recommended that the colleges should be pressed to satisfy themselves that all their students are suitably equipped to benefit by their course of instruction, and that a more rigorous attitude should be adopted in the weeding-out of students who are not availing themselves of their opportunities. At the same time, it is desirable that every effort should be made to increase the numbers of students drawn directly from agricultural circles, which can be encouraged by scholarships given by the Ministry and by county authorities. There seems to be scope for a much greater measure of county assistance in this respect.

The attention of the Committee was also directed to the question of adequate farm areas attached to the colleges. Although most colleges already possess such farms, in some cases they might be used more freely for the practical instruction of the students. For urban colleges, the distance to the farm may present difficulty, and in one instance the establishment of a local farm institute on the farm itself has been recommended as the condition of the continuance of the existing grant.

In spite of the reduced incomes, due to various causes, it is most undesirable that any increase in the level of fees paid by students should be made, as even now the cost is too heavy for members of the agricultural classes without the aid of scholarships or reduced fees. The heavy burdens of interest charges and bank overdrafts could best be dealt with

by increases of grant sufficient for their gradual reduction. Considerable items of capital expenditure still call for the Ministry's contribution on a pound for pound basis; but if possible, smaller items should be met out of a margin provided by an adequate annual grant.

As a measure of security for the proper use of the suggested increased grants, the report proposes that annual visits should be paid to colleges and farms by responsible officials and technical officers of the Ministry. It also recommends that members of the county committees should periodically visit any college to which a grant is made, with the view of increasing the co-operation between colleges and counties.

If the suggestions outlined above are put into force, the position of the agricultural colleges of Great Britain will be greatly strengthened, and they will be enabled to make a much greater contribution towards improving agricultural practice throughout the country.

International Longitude Operations

THE Observatory of Zi-Ka-Wei, which took part in the International Programme of Longitude Operations in October and November 1933, in addition to transmitting its results to the Commission of the International Astronomical Union responsible for the general reduction of the whole work, has published its own observations in its *Annales* (t. 20).

The Observatory kept its own time with two pendulums, Leroy 1227 and 1338, working at constant pressure and a temperature controlled by a thermostat. Meridian observations were made with two transit instruments, the Zi-Ka-Wei instrument used in 1926 and a similar instrument which was brought from Nice by M. Fayet. Observations with both instruments were secured on twenty-eight nights by four observers, each of whom used both instruments. The maximum difference between the clock errors deduced from the two instruments on the same night was $0{\cdot}04^s$, and the difference was generally less than $0{\cdot}02^s$. Wireless time signals were received from a number of stations, including DFY (Nauen) and FYL (Bordeaux). Time lags in the reception of the wireless signals were determined by a method due to M. Jouast, and it is hoped that their effect has been eliminated. The longitude of Zi-Ka-Wei minus Paris is found to be $7^h\ 56^m\ 21{\cdot}962^s$ in 1933, as compared with $21{\cdot}975^s$ in 1926. The difference between the two determinations is thus $0{\cdot}013^s$ (the equivalent of 17 ft. on the earth's surface) which is presumably scarcely outside the limit of accidental error; but it is of interest from the point of view of continental drift to note that observations of this kind would certainly have shown up a drift of seventy feet on the earth's surface during the seven years that elapsed between the two determinations. It is certain that the reality or otherwise of continental drift will be settled by these precise longitude observations, when a long enough time interval has elapsed.

The director of the Zi-Ka-Wei Observatory directs attention to a puzzling periodic variation from the mean longitude with an amplitude of $0{\cdot}05^s$ and period of one month. This is shown by the 1933 observations as well as by those made in 1926. He concludes that it is not possible to incriminate either the meridian observations or the reception of the time signals, and is inclined to attribute these fluctuations to a periodic deformation of the earth's crust. One is reminded of a somewhat similar effect in the longitude difference Washington minus Greenwich, which has been pointed out by Loomis and Stetson. The precise nature of the cause of this variation is obscure.

Biology and Variation of *Ceratium*

THE introductory report* (No. 1) to the Carlsberg Foundation's Oceanographical Expedition contains an article in memory of its late leader, Prof. Johannes Schmidt, by Martin Knudsen, with portrait, a foreword by P. Jespersen and Å. Vedel Tåning, a list of stations and, finally, the results with detailed tables of the echo-soundings, with introductory remarks by Sv. Greve. There are also seven maps showing the stations.

This was the last and the greatest of the many expeditions in which Schmidt personally took part, from June 14, 1928, until June 30, 1930. Like all those which he conducted, it was planned and conceived in every detail by himself. He took care that the investigations were as many-sided as possible, and maintained his interest in discovering connexions between the biological and physico-oceanographical conditions. The principal features in the biological-zoogeographical methods of work and the plans for the Expedition were drawn up by him in the following summary:—

(1) With the aid of the most efficient apparatus to obtain a very large material, rich in individuals, of the pelagic life in the different depths and the various oceans.

(2) With the aid of simultaneous, methodical investigations on the physical and chemical composition of the different water layers, to obtain data which would permit us to conclude under what environmental conditions each single one of the millions of pelagic organisms, taken in the nets, may live.

* The Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 and Previous *Dana* Expeditions under the Leadership of the late Prof Johannes Schmidt. Dana-Report No. 1. Introduction to the Reports from the Carlsberg Foundation's Oceanographical Expedition round the World 1928–30. Pp 130+7 plates. 16*s* net. No 4. Untersuchungen uber die Verbreitung, Biologie und Variation der Ceratien im südlichen stillen Ocean, von E. Steemann Nielsen. Pp. 67. 8*s*. net (Copenhagen. C. A. Reitzel's Forlag. London: Oxford University Press, 1934.)

(3) By means of the large pelagic material to subject a number of important oceanic species or genera to a finer analysis, with reference to classification, than has previously been possible with the frequently somewhat scanty material available from the distant waters.

The Expedition was successful in every way, and the results of the investigations now being published show its extreme value. It is to be regretted deeply that Schmidt did not live to see more of the fruits of his carefully planned work. The reports now being published are to appear in parts. No. 2 (Deep-Sea Angler Fishes (Ceratioidea)), by C. Tate Regan and Ethelwyn Trewavas, was published in 1932. Dr. Nielsen, who took part in the Expedition, now contributes an important monograph (No. 4) on the Ceratia in the southern Pacific Ocean. The genus is taken as representative of the phytoplankton and the whole work touches on many vital problems.

The *Ceratium* material is from two Danish Expeditions of the steamer *Dana*. In January 1922 in the Gulf of Panama and in September 1928–March 1929 on the present Expedition, through the Pacific Ocean from Panama to New Zealand–Australia, 68 stations were sampled, and in all the oceanic stations the Nansen closing net was used. Whilst on the first Expedition samples were taken at other depths, in 1928–29 the catches were almost wholly made at the depths 200–100 metres, 100–50 metres, 50–0 metres. The surface net was only used at shallow coastal stations where a vertical separation of species of *Ceratium* would be unimportant. Sixty species were recognised besides several sub-species and variations.

The larger part of these *Ceratium* species are oceanic, but a few are typically inhabitants of coastal waters, that is, neritic. The author's main conclusions are that temperature, currents and oceanic-neritic waters are the chief factors influencing the horizontal distribution of the *Ceratia*, the variation in the species depending on the first and the last. He finds that a rising temperature tends to lessen the size of the cell, and, in some species, there is a lengthening of the horns at the same time. Under a neritic influence the cells are usually large and there is almost always a lengthening of the horns. The case of *Ceratium fusus* is striking, for in neritic waters it is nearly double the size of that in purely oceanic conditions. The cause of this large size is evidently not the better nourishment of the cell, since the *Ceratium* population in the eutrophic east equatorial stream where the neritic influence is much felt are no greater than in the oligotrophic oceanic stations with the same surface temperature. The author is of the opinion that the dearth of *Ceratium* species in purely neritic waters compared with the large numbers in the oceanic stations is to be attributed to the accumulation of the waste products from the breaking down of the many organisms in neritic regions where the water is only renewed very slowly, these substances being usually poisonous to the sensitive oceanic species.

There is a striking agreement of the *Ceratium* populations in the Pacific and Atlantic Oceans, few species being peculiar to one or the other.

It is shown that the genus has a very characteristic depth distribution. About a third of those found in the Pacific are so-called 'shadow' species. In the plankton-poor water these were found chiefly in the samples below 50 metres, whilst most of those where the plankton was rich were chiefly above this depth. The 'shadow' species are all oceanic. They require only a moderate light intensity, but in those waters where there is abundance of plankton this moderate light intensity is nearer the surface. All *Ceratium* species which have a very broad flattened body or in some other way have the assimilation surface enlarged are 'shadow' species. In those regions where they live, the nutrient salts are always considerable.

Genetics at Cold Spring Harbor, N.Y.

THE latest annual report of Dr. C. B. Davenport for the Department of Genetics at Cold Spring Harbor is contained in Year Book No. 33 of the Carnegie Institution of Washington for 1934. It covers the usual wide range of investigations bearing on genetics in plants, animals and man. Only a few of these researches can be cited here. Demerec has surveyed the X-chromosome of *Drosophila* for minute deficiencies or cell-lethal mutations produced by X-rays. In 12 out of 13 cases the deficiency of a single locus caused cell death, which supports the view that nearly all the genes take a vital part in the functioning of every cell. In *D. virilis*, a gene producing intersexes has been found.

Blakeslee and Bergner find that, in *Datura discolor*, five of the twelve pairs of chromosomes have exchanged segments in comparison with *D. stramonium*, and these species when crossed give a ring of 10 chromosomes in the hybrid. Older seeds are shown by Cartledge to have a higher mutation rate than young seeds, and it was found that bad pollen could be used as an index of the mutation rate in aged seeds, which produced mutations at thirty times the rate of the controls.

Problems of leukæmia and immunisation in mice are investigated, and an account is given of Dr. Riddle's work on hormones, especially in pigeons. The antepituitary secretion has been most studied, both in pigeons and in cattle, some of the results receiving clinical application. It is shown that the gonad-stimulating hormone in rabbits also causes ovulation, but conclusive evidence is obtained that a separate pituitary principle stimulates the thyroid, also affecting the basal metabolism. The shaker mouse is found to show a defect in the *area striata* of the brain, and a circling mouse mutation is probably due to two recessive genes with variable expression. In the parasitic wasp, *Habrobracon juglandis*, Whiting has obtained sixty mutations. Some are sex-linked and form the basis for a theory of sex inheritance in this species with haploid males.

In human genetics there have been studies of growth in children, of the errors of physical anthropometry on the living subject, racial growth differences of Indians, Negroes and Dutch, and researches by Laughlin on immigration policy.

Educational Topics and Events

CAMBRIDGE.—The King has been pleased to approve the appointment of Dr. John Alfred Ryle to be regius professor of physic in the University in succession to Sir Walter Langdon Brown, who retires on September 30.

LIVERPOOL.—Dr. Hubert Horace Stones has been appointed Louis Cohen professor of dental surgery and director of dental education, from October 1 next, in succession to Prof. W. H. Gilmour, who retires at the end of the present session. Dr. Stones is an honorary dental surgeon to University College Hospital Dental School, London, and a research worker at the Hale Research Laboratory of the Royal Dental Hospital of London.

PROF. T. GRIFFITH TAYLOR, professor of geography in the University of Chicago, has been appointed professor of geography in the University of Toronto. This is the first independent chair of geography to be established in Canada. Dr. Taylor was associate professor of geography in the University of Sydney in 1920–28. He was senior geologist in Capt. Scott's last expedition to the south pole in 1910, and led other parties to the Antarctic in 1911–12.

EDUCATIONAL problems have in recent years engaged the attention of a multitude of investigators in the United States. In addition to the very numerous and comprehensive researches conducted by the staff of the Federal Office of Education, by State officials and by educational foundations, hundreds of systematic investigations have been carried out by candidates for the degree of doctor in education. A list of 797 theses submitted by such candidates and deposited with the Office of Education, where they are available for loan, has just been published by the Government Printing Office, Washington (pp. 69, price 10 cents). The titles are listed under a hundred subject headings arranged alphabetically, beginning with administration and ending with vocational guidance, with very full cross references under other headings. More than ten per cent of the theses are listed under the heading 'psychology'.

A DEPARTMENT of Business Administration was established at the London School of Economics in the University of London in 1930. Business men have from the outset played an active part in the work of the Department. At the end of the five-year experimental period, the Governors of the London School of Economics have decided, in view of the success which has attended the Department, to make it an integral and more permanent part of the work of the School. In that decision they are supported by the business men associated with the management of the venture. Several of the business firms which contributed towards the cost of the original experiment are generously continuing their financial support of the Department, and additional firms are also assisting. The active co-operation of business men in the actual conduct of the work is being continued in all its aspects, by the establishment of a Business Administrative Council of business men of widely diverse interests. A number of firms now favour the Department's University Scheme as a means of recruiting graduates. Some firms are in a position to offer appointments each year, others do so from time to time as vacancies occur. The post-graduate course of training, extending over one year of full-time study, remains the principal work of the Department. Students working for higher degrees, and wishing to undertake an investigation of a particular business problem as part of their work, may now combine attendance at the post-graduate course with their research. Particulars of the arrangements for the forthcoming session can be obtained from Prof. Arnold Plant, Department of Business Administration, London School of Economics, Houghton Street, Aldwych, London, W.C.2.

EDUCATIONAL broadcasting in the United States of America was discussed on May 15 at a conference called by the Broadcasting Division of the Federal Communications Commission. A statement made before the conference by the United States Commissioner of Education is reproduced in *School and Society* of June 15. It is remarkable for its insistence on the vital importance of safeguarding freedom of access to the microphone for exponents of all "the important ideas which struggle for acceptance in our complicated world order, so that our people can make intelligent choices in the determination of their destiny". The radio transmission systems in the United States being privately owned and operated, it is incumbent on the Federal Government to prevent their exploitation in the exclusive interests of any one body of doctrine and to ensure, on the contrary, the presentation of differing points of view in well-balanced programmes. With the progressive shortening of hours of labour in factories the field of influence of adult education by radio is rapidly expanding, and the Commissioner's announcement of his readiness to co-operate in a plan for the improvement of education by this means is timely. Much harm has been done by broadcasters imperfectly instructed in the technique of teaching by radio.

Science News a Century Ago

Death of Dr. John Brinkley, F.R.S.

ON September 14, 1835, Dr. John Brinkley, Bishop of Cloyne and Royal Astronomer of Ireland, died at his brother's house in Leeson Street, Dublin, at the age of seventy-two years. Born at Woodbridge, Suffolk, in 1763, he was enabled to enter Caius College, Cambridge, and in 1788 was senior wrangler and Smith's prizeman. While studying for his degree, he had assisted Maskelyne at Greenwich, and in 1790, largely through the influence of Maskelyne, he was chosen to succeed Henry Ussher as Andrews professor of astronomy in Trinity College, Dublin, and director of Dunsink Observatory, which had been erected under the superintendence of Ussher. A fine circle had been ordered for the observatory in 1785 from Ramsden, but this instrument was not completed until twenty-three years later, and Brinkley at first confined himself to mathematical work, contributing papers to the Royal Irish Academy and the Royal Society. On the erection of the 8-ft. circle at Dunsink he began researches on aberration and nutation, and made an attempt to determine the parallax of a fixed star. He also published his "Elements of Astronomy", which went through several editions, and his new theory of refraction, and computed the elements of the comets of 1819 and 1821. For this and other work he was made a vice-president of the Royal Society and president of the Royal Irish Academy, and in 1824 received the Copley Medal for his "Various Communications to

the Royal Society". Taking the degree of D.D. in 1806, he became prebendary of Kilgoghlin and rector of Derrybrush, in 1808 was made archdeacon of Clogher, and finally in 1826 bishop of Cloyne. His episcopal work from this time occupied much of his energy, and for the last ten years of his life he contributed little to science. He was buried in Trinity College Chapel, and a marble memorial to him was erected in Cloyne Cathedral. His best memorial, said Ball, was his admirable book on the "Elements of Plane Astronomy". He was succeeded in the Andrews chair by William Rowan Hamilton, whose genius he had long recognised.

Darwin in the Galapagos Archipelago

CHAP. xvii of Darwin's "Journal of Researches" contains his account of the visit of H.M.S. *Beagle* to the Galapagos Archipelago, the survey of which occupied from September 15 until October 20, 1835. "The archipelago," Darwin wrote, "consists of ten principal islands, of which five exceed the others in size. . . . They are all formed of volcanic rocks; a few fragments of granite curiously glazed and altered by the heat, can hardly be called an exception. Some of the craters surmounting the larger islands, are of immense size, and they rise to a height of between three and four thousand feet". Darwin landed on several of the islands of which, he said, the natural history is eminently curious and well deserving attention. "The archipelago is a little world within itself, or rather a satellite to America, whence it has derived a few stray colonists, and has received the general character of its indigenous productions. Considering the small size of these islands we feel the more astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period, geologically recent, the unbroken ocean was here spread out. Hence both in space and time we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth".

Green's Night in a Balloon

CHARLES GREEN (1785–1870), the first aeronaut to make an ascent with carburetted hydrogen gas, spent a night in the air on September 17, 1835. Writing to *The Times* on September 20, 1835, on his late aerial voyage from the Royal Gardens, Vauxhall, he said he ascended with Mr. Butler at quarter to six on Thursday evening, September 17, and at about quarter past six descended at Walthamstow. He then determined to stay in the air all night so, leaving Mr. Butler behind, he reascended, passed over Bishops Stortford, Royston and Huntingdon and at quarter to six on Friday morning landed in the parish of Wimbotsham, near Downham in Norfolk. He partook of an excellent breakfast at the residence of Mr. J. Pike. Then he again ascended and descended at 10.30 a.m. near Lynn, Norfolk. "I received numerous congratulations," he said, "though many persons I believe doubted the statement of my having been in the air during the past night. . . . I remained in the air altogether about 13 hours and from the zigzag direction of my course must have travelled about 130 miles. From the very trifling loss of power the balloon sustained during the whole of this time, I judge I might have remained up at least five days and nights."

Societies and Academies

PARIS

Academy of Sciences, July 22 (*C.R.*, **201**, 245–308). LOUIS BLARINGHEM: A new case of unilateral heredity observed on hybrids of sages (*Salvia nemorosa* × *S. Sclarea*). STANISLAS GOLAB: The relation between the ideas of measurements of angles and areas in Finsler spaces. ANDRÉ FOUILLADE: Unicity with a nearly constant factor, in an undecomposable ensemble, of a function of the ensemble invariant with respect to the transformation associated with a positive, linear functional transformation maintaining unity. JEAN BRAÏTZEFF: A particular case of the distribution of the singular points of a function defined by a Dirichlet series. MIECISLAS BIERNACKI: Some majorants of the theory of univalent functions. PAUL NOAILLON: Sudden expansion in a gas. MIROSLAV NÉNADOVITCH and MAURICE DENIS: Contribution to the experimental study of the stability of certain biplane cells at large incidences. P. CHEVENARD and X. WACHÉ: The accelerating effect of a sinusoidal mechanical tension on the changes in a hypertempered iron-nickel-chromium-carbon austenite. The accelerating effect of the sinusoidal pressure on the precipitation of the carbides is very marked. This results in a certain increase in the mechanical resistance when hot; but in some cases leads to fragility, giving rise to breakage without sensible deformation. RAYMOND TREMBLOT: A contrast star photometer. A modification of the Fabry and Buisson photometer without diffusing screens allowing a better utilisation of the light available when the measurements are carried out on point sources of light of very small luminosity. An accuracy of 0·01–0·02 magnitude is possible. ANDRÉ LÉAUTÉ: The capillary ascent of tars and bitumens. Application of the method previously described to the study of the causes of the changes in a road surface, originally satisfactory but later slippery. MME. LINA GUASTALLA: The oxido-reduction process at the level of a (kaolin) partition interposed in a copper solution, in the course of electrolysis. The factors determining the velocity of its appearance. MARCEL CAU and FÉLIX ESCLANGON: The coherence of light radiations and the possibility of using interference apparatus as monochromatic light sources. WITOLD BRONIEWSKI and W. LEWANDOWSKI: The influence of sulphur on the properties of copper. Amounts of sulphur varying from 0·0 to 0·7 per cent were added to copper, and measurements made of the changes in electrical conductivity, temperature coefficient of the electrical conductivity, thermo-electric power (against lead), breaking load, elastic limit, elongation before breaking and Brinell hardness. The results are given graphically. ROGER PERROT: The action of nitrosyl chloride on some silver salts. M. TIFFENEAU, P. WEILL, J. GUTMANN and B. TCHOUBAR: Molecular transpositions in the cyclane series. Lengthening and shortening of the rings. CHARLES DUFRAISSE and ANDRÉ ETIENNE: The dissociable organic oxides. The anthracene structure possesses reversible oxidisability: a dissociable oxide of mesodiphenylanthracene. From the study of the rubenes, the authors have deduced a structure for substances capable of reversible photoxidation, and mesodiphenylanthracene possesses such a structure. This substance has been found to absorb free oxygen, forming a crystallised photo-oxide: it dissociates at

200° C. into pure oxygen and the free hydrocarbon. ALBERT F. DE LAPPARENT: The Trias band of Barjols (Provence). JACQUES FROMAGET: The existence of the lower Trias with ocean facies to the south of Luang-Prabang (Laos) and on the palæogeography of south-eastern Asia at this period. CHARLES PÉREZ: Stages in the disappearance of the roots of *Peltogaster* after the fall of the visceral sac. PIERRE GRASSÉ and PAUL BONNEVILLE: Non-swarming imagos or achrestogonimes of the Protermitids. MARIUS BACCINO: The thermal adaptation of the nests of mammals during the growth of the young. The temperature of the nest in the case of rabbits falls as the age of the young increases. For each age there is a temperature of maximum growth. ALBERT and PAUL CHAUCHARD and MME. BERTHE CHAUCHARD: The action of nicotine on the preganglion and postganglion sympathetic nerve fibres. FRIEDRICH L. HAHN: The determination of very small quantities of ethyl bromide in biological media. ANDRÉ KLING, EMILE GELIN and JULES DEMESSE: The possible substitution, for the analysis of various natural plant products or their derivatives, of the determination of total carbon for that of the dry extract. The carbon dioxide obtained on oxidation with chromic and sulphuric acids gives a measure of the dry extract with sufficient approximation and offers a considerable saving in time. EDGAR LEDERER: Echinenone and pentaxanthine: two new carotinoids found in *Echinus esculentus*. A. BESREDKA, J. MAGAT and P. BESNARD: The vaccination of rabbits against cutaneous epithelioma. EMILE ROUBAUD and MARC TREILLARD: A coccobacillus pathogenic for tsetse flies.

GENEVA

Society of Physics and Natural History, July 4. E. BRINER, F. CHODAT and H. PAILLARD: The presence of ozone in the air, and its action on the growth of plants. B. SUSZ, E. PERROTTET and E. BRINER: Raman spectra and reactivity: eugenol, isoeugenol, vanillin and methyl derivatives, safrol, isosafrol, heliothropin, anethol and estragol. M. A. PUTNES: Stokes's theorem for heterogeneous ellipsoids in permanent rotation. R. WAVRE: Figures of equilibrium. K. H. MEYER and G. W. PANKOW: The chloride of polyphosphonitrile. P. WENGER, Ch. CIMERMAN and MLLE. C. RZYMOWSKA. The volumetric micro-estimation of potassium in blood serum. L. A. DESHUSSES and J. CORBAZ: (1) The fractionation of oily constituents by distillation. (2) The separation of oily constituents by extraction with ether. E. CHERBULIEZ and A. MIRIMANOFF: The differential estimation of the polypeptides and aminoacids of the serum by the use of ninhydrin. HELD and MLLE. PONSE: The thyreostimulating activity of the blood of thyroidectomised or normal guinea-pigs. F. WYSS-CHODAT. (1) Notes on transmissible microbial lysis. (2) The reducing power of milk. Reductase and coreductase. A. MIRIMANOFF: (1) The estimation of the aminoacids of the blood serum by tyrosinase. (2) Remarks on the growth factors of the must of grapes. E. BRINER, S. FRIED and B. SUSZ: The Raman spectra of solutions of pyrogallol, gallic acid and tannin. E. PITTARD: Intentionally broken teeth of the ox and horse of the Mousterian period. T. POSTERNAK: (1) The phosphorus of starch. (2) A new tetroxyadipic acid.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 7, 1935). RENÉ CALAPSO: Configuration (T) of Finikoff and the projective elements attached to it. N. V. ADAMOV: Some conditions of stability. B. V. NUMEROV: Problem of the determination of systematic errors of star positions. D. N. CHRAMOV: Determination of anomalous values of the vertical gradient of gravity from the anomalies of gravity. E. M. BRUMBERG: A new method of producing monochromatic light. V. FREDERICKS, G. MICHAJLOV and D. BENESZEVICH: Dielectric losses in anisotropic fluids. B. I. DAVYDOV: Diffusion equation with reference to molecular velocity. A. G. SAMARCEV: Cathodic passivity of silver in solutions of silver nitrate. A. A. GRÜNBERG and L. M. WOLSTEIN: Mechanism of action of glycocol on potassium tetrachloroplatinate. I. N. EFIMOV: Modifications of facial conditions along the strike of the roofing of coal measures in the Donetz basin. A. A. PROKOFJEVA-BELGOVSKAJA: The structure of the chromocentre. S. G. LEVIT: Dominance in man.

SYDNEY

Royal Society of New South Wales, July 3. ADOLPH BOLLIGER: Volumetric microdetermination of magnesium with methylene blue following its precipitation as magnesium picrolonate. Magnesium, as well as calcium, forms a sparingly soluble picrolonate which, however, in contrast with calcium picrolonate, is not precipitated from dilute solutions at room temperature. However, magnesium salts were found to be precipitated quantitatively as magnesium picrolonate by heating and partially evaporating the solution in which they are contained. The analytical principle applied is as follows: a known excessive amount of lithium picrolonate is added to the aqueous solution containing the magnesium, precipitation is brought on by heating and evaporation, and the excess of picrolonate added is determined by titration with methylene blue. The limitations of the method are discussed. G. F. K. NAYLOR: Note on the geology of the Goulburn district, with special reference to Palæozoic stratigraphy. The first record of Lower Silurian strata in this State. These rocks were identified by their content of graptolites, a group of organisms the remains of which have also proved invaluable in determining the extent of the Upper Ordovician and Upper Silurian strata in the same district. The author shows that, on palæontological and structural evidence, the Palæozoic strata near Goulburn form a broad synclinal structure, the core of which is occupied by the Upper Devonian mass of the Cookbundoon Mountain, and the hill on which the Goulburn War Memorial is situated.

VIENNA

Academy of Sciences, July 4. ERNST SPÄTH and FRIEDRICH BECKE: Cactus alkaloids (15). Separation of anhalonium bases. GUIDO MACHEK: Action of aromatic sulpho- and oxysulpho-acids on α- and β-amino acids. ERNST FÖYN, ELISABETH KARA-MICHAILOVA and ELISABETH RONA: Artificial transformation of thorium by neutrons (1). GUSTAV ORTNER and RICHARD ZENTNER: Measurement of the natural breadths of X-ray lines. The possibilities of using a single-crystal spectrometer for measuring these breadths photographically were investigated.

ELVIRA STEPPAN: Problem of the disintegration of aluminium, treated by the photographic method. JOSEF SCHINTLMEISTER: The question of the existence of unknown natural α-rays. These rays, of range $R_{15} = 2 \cdot 2$ cm., occur always in conjunction with samarium and exhibit marked chemical affinity with this element. The carrier of the activity observed is most probably thulium or, at any rate, element No. 61. HEINRICH MACHE and GEORG MARKSTEIN: Output of emanation to water flowing over radium-containing rocks. The view has been expressed that, owing to the slight capacity of rocks for occluding indifferent gases, the quantity of emanation passing into spring water per unit of time and per unit of rock-surface must be independent of the concentration of the emanation present in the water. Experimental results now obtained agree with this view. RUDOLF KANITSCHEIDER: Terrestrial magnetic observations of the Austrian Polar Expedition to Jan Mayen, 1932–33. The results obtained for 1933·0 are: declination, − 22° 40′; horizontal intensity, 11,700γ; vertical intensity, 50,400 γ. H. L. WERNECK: Phenology of Upper Austria, 1926–30. OTTO FÜRTH and HEINZ HERRMANN: Colour reactions of tartaric, citric and aconitic acids. When heated with pyridine and acetic anhydride, citric acid gives a carmine, aconitic acid a violet-red, and tartaric acid an emerald-green coloration. J. P. REIMER: Nebulæ in the region of *o*-Persei. HANS KRUMPHOLZ: Course of the brightness of Nova (1934) Herculis to the beginning of April 1935. FRANZ RINAGL: Flow limits and bending. ARMIN DADIEU and WOLF ENGLER: Raman spectra of C_2H_5SeH and C_2H_5SeD. The frequencies for the SeH − (2303 cm.$^{-1}$) and SeD − (1665 cm.$^{-1}$) vibrations agree well with those previously found for SeH_2 (2313 cm.$^{-1}$) and SeD_2 (1665 cm.$^{-1}$). ARMIN DADIEU and OTTO KERMAUNER: Structure of half-heavy acetylene. Comparison of the Raman spectra of C_2H_2, C_2D_2, and a product obtained from CH : CNa and D_2O indicates that this product contains about 50 per cent of C_2HD, with 25 per cent each of C_2H_2 and C_2D_2. The product of the reaction of C_2Na_2 with a mixture of D_2O and H_2O in equal proportions gives a spectrum identically the same. ALFONS KLEMENC, R. WECHSBERG and G. WAGNER: Preparation of carbon suboxide. The separation of carbon suboxide from its mixture with carbon dioxide and keten, obtained from diacetyltartaric anhydride, is described. MORITZ KOHN: Action of oxalates on blue iron-cyanogen compounds. OTTO DISCHENDORFER and AUGUST VERDINO: 2:6-Dibenzoylhydroquinone. K. W. F. KOHLRAUSCH and GR. PRINZ YPSILANTI: Raman effect (45). Raman spectrum of organic substances (polysubstituted benzenes, 7). The substances examined were of the type, $X.C_6H_4.OCH_3$, where X = NH_2, OH, CH_3, F, Cl, Br, I, or CN. A. PONGRATZ and R. SEKA: Raman spectra of benzenepolycarboxylic esters. Methyl and ethyl iso- and tere-phthalates, and trimethyl benzene-1:2:3-tricarboxylate were examined. The C–C ring linkings behave similarly to those in open-chain unsaturated compounds. K. W. F. KOHLRAUSCH and W. STOCKMAIR: Raman spectra of nucleus-substituted ethyl benzoate. The substituents were NH_2, OH, Cl, Br, NO_2. EUGEN GUTH: Theory of the scattering of charged particles at atomic nuclei (with a special application to the scattering of protons at protons). KARL SCHWARZ: Transport number and valency of silver in silver amalgam. VICTOR F. HESS: Daily course of cosmic ultra-radiation. Wagner's criticisms are discussed.

Forthcoming Events

IRON AND STEEL INSTITUTE, September 16–18. Autumn meeting to be held in Manchester.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 20–23.—Annual conference to be held in St. John's College, Cambridge.

Sir Richard Gregory: "Interpretation of Science" (Presidential Address).

Official Publications Received

Great Britain and Ireland

Scottish Society for Research in Plant Breeding. Report by the Director of Research to the Annual General Meeting, 25th July, 1935. Pp. 29. (Edinburgh: Scottish Society for Research in Plant Breeding.)

Queen Mary College (University of London). Calendar, Session 1935–1936. Pp. 260. (London: Queen Mary College.) 1*s*.

Proceedings of the Royal Irish Academy. Vol. 42, Section A, No. 3: A New Method for counting Atmospheric Ions and determining their Mobilities. By J. J. Nolan and P. J. Nolan. Pp. 15–19. Vol. 42, Section A, No. 4: Vortex Polygons. By W. B. Morton. Pp. 21–29. 1*s*. Vol. 42, Section No. 5: The Faraday Dark Space. By K. G. Emeleus. Pp. 31–36, Vol. 42, Section B, Nos. 10, 11, 12: The Physiological Basis of the Sensation of Cold. 1: The Influence of the Initial Skin Temperature on the Excitability of the Cold Eng Organs, by J. M. O'Connor; 2: The Analogy between Human Cold Sensations and Shivering in the Rabbit, by J. M. O'Connor, M. Moriarty and O. Fitzgerald; 3: the Influence of the Body Temperature on the Resting Oxygen Consumption—A Metabolic Analogy to Cold Sensations, by J. M. O'Connor. Pp. 327–357. 1*s*. Vol. 42, Section B, No. 13: Some 2.4.Derivatives of Thiophene. By R. O. Cinnéide. Pp. 359–363. Vol. 42, Section B, No. 14: Excretion of Glucose by the Rabbit Kidney. By T. W. T. Dillon and R. O'Donnell. Pp. 365–405. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1935–36. Pp. 83. (London: London County Council.)

Sixth Report on the Heterogeneity of Steel Ingots: being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. (Special Report No. 9.) Pp. vi+236+37 plates. Waste-Heat Boilers in Open-Hearth Practice: Second Report of the Open-Hearth Committee, being a Committee of the Iron and Steel Industrial Research Council. (Special Report No. 10.) Pp. iii+73+2 plates. (London: Iron and Steel Institute.)

Other Countries

U.S. Department of the Interior: National Park Service. Fauna of the National Parks of the United States: Wildlife Management in the National Parks. By George M. Wright and Ben H. Thompson. (Contribution of Wildlife Division, Fauna Series, No. 2.) Pp. viii+142. (Washington, D.C.: Government Printing Office.) 20 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 146: Egyptian Plant Diseases, a Summary of Research and Control. By G. Howard Jones. Pp. v+45+8 plates. 5 P.T. Bulletin No. 152: An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt. By David S. Gracie and Dr. Fahmy Khalil, in collaboration with Hussein Enan. Pp. v+71+12 plates. 10 P.T. (Cairo: Government Press.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol 94, Partie 1: Procès-verbaux (Mai 1935). Pp. 55. 3.00 kr. Vol. 94, Part 3: Appendices (1934–1935). Pp. 77. 3.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 55: The Selection, Preservation, Distribution and Identification of Australian Pole Timbers. By J. E. Cummins and H. E. Dadswell. (Division of Forest Products: Technical Paper No. 17.) Pp. 79+7 plates. Pamphlet No 57: Tests of the Efficacy of the Oxy-Acetylene Scouring and Charring Process for Sterilising Partly Decayed Poles. By J. E. Cummins. (Division of Forest Products: Technical Paper No. 18.) Pp. 43. (Melbourne: Government Printer.)

Forest Department: Trinidad and Tobago. Leaflet No. 6: Notes on Insect Attack on Mora (*Mora excelsa* Benth.) in Trinidad. By C. Swabey. Pp. 39. (Trinidad Government Printing Office.) 6*d*.

Ingeniørvidenskabelige Skrifter. A, Nr. 39: A New Device for Direct Stream Field Studies and its Application; with an Appendix on the Pressure Distribution on a Triangular Prism. By Paul Neményi. Pp. 23. (Copenhagen: G. E. C. Gad.) 3.00 kr.

Journal of the Indian Institute of Science. Vol. 18A, Part 11: Hydrogen Ion Concentration of Lead Solutions. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp. 75–83. 14 annas. Vol. 18A, Part 12: Studies in Antimony Electrode. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp. 85–100 1.4 rupees. Vol. 18A, Part 13: pH Control of Rotary Drilling Fluids. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp 101–107. 12 annas. (Bangalore: Indian Institute of Science.)

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 152: An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt By David S. Gracie and Dr. Fahmy Khalil, in collaboration with Hussein Enan. Pp. iii+71+12 plates. (Cairo: Government Press.) 10 P.T.

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3438 SATURDAY, SEPTEMBER 21, 1935 Vol. 136

The Forestry Commission*

THE fifteenth annual report of the Forestry Commission presents a record of the work carried out by the Commissioner since its establishment in 1919. The fifth and the tenth annual reports gave similar general reviews of the work done in the first and the second quinquennium respectively.

The wide and expanding scope of the work which is being carried out by this young and energetic Government Department is shown at a glance by the full 'contents' of the report before us. In spite of its fifteen years of existence, the Forestry Commission is still merely in the first phase of its existence; the Commission, like the forest, cannot be regarded as full fledged and in full working order until a complete forest rotation has run its course, and, as is well known, a forest takes many decades to reach maturity. The Transfer of Woods Act, 1923, however, placed fifty-six thousand acres of existing forest under the care of the Forestry Commissioners, and this brings under their administration the whole range of forestry practice. Nevertheless, the chief function of the Commission is meantime to create and re-establish forests adequate to supply at least part of the needs of Great Britain in timber of economic value.

At September 30, 1934, the Commissioners had under their charge approximately 909,000 acres of land, which gives an indication of the progress made since 1919. A further idea of the progress being made in afforestation by the Commissioners is afforded by the number of manual workers employed in their forests. The summer minimum in 1920 was 210; and the winter maximum in 1920–21 was 935. In 1934, the summer minimum had increased to 3,015, and the winter maximum of 1934–35 was 4,020. The intermediate figures of employment show a steady increase during the intermediate years, and as time goes on the numbers are bound to increase not only as the area under forest expands, but also as the plantations approach the thinning stage. These operations will involve cutting, haulage, preparation, and road, rail and to some extent sea transport to the mines and other timber consuming centres. A drop of a thousand or two in the figures of unemployment is hailed with delight as a sign of economic progress and recovery. This new national industry, set upon its feet by the establishment of the Forestry Commission, is undoubtedly pulling its weight.

The funds at the disposal of the Commissioners are being deposited in a safe bank. If we look at the question from the point of view that it is not the forester but Nature which produces the timber, we get a clearer idea of the economic basis of forestry. The forester by his labour and a certain amount of capital outlay in material produces conditions which enable Nature to become his ally in the direction he desires. Once he has placed the right tree in the right environment, natural growth factors such as sunlight and temperature, with a suitable amount of air and soil moisture, enable the living machine to get to work and from the carbon dioxide of the air and a small amount of mineral food materials from the soil, timber, which consists mainly of carbon, is produced. The raw material is cheap and abundant. The carbon from the air costs nothing and the small quantity of minerals from the otherwise idle soil is being put to a useful purpose, and as time goes on the productive capacity of the soil is improved, under suitable sylvicultural management. Surely then, something for nothing, with

* Forestry Commission. Fifteenth Annual Report of the Forestry Commissioners for the year ending September 30th, 1934. (London: H M. Stationery Office, 1935.) 2s. net.

raw material inexhaustible, if properly used, is an attractive proposition. The forest capital is increasing in direct ratio to the rate of growth of the trees. The forester organises the industry in which Nature supplies the driving power and the raw material. The trees are his 'workmen', which if properly treated are busy night and day with no 'off' time or unemployment. There are therefore, surely, a few concerns in which money, especially national funds, can be applied with more safety or greater mutual benefit to all.

A perusal of the Forestry Commissioners' report shows that everything possible is being done in regard to land acquisition and planting, education, research, and the development of forest technique. Research and experiment in regard to the production of timber under varying conditions, the establishment of new plantations, the treatment, protection and utilisation of established plantations, have already led to improved and more efficient methods of practice. Sound methods of practice depend upon as complete a knowledge as possible of the biology of our trees and of the forest as a whole. One of the weak points in British forestry until now has been our almost complete neglect of the study of the relationship between our trees and soil. This has been due mainly to lack of men and facilities, but it will be remedied in the future, as the Commissioners have made a grant to the Macaulay Institute for Soil Research at Craigiebucklar near Aberdeen for the investigation of forest soils, including questions relating to the fertility of forest tree nurseries. Such investigation, in conjunction with studies in forest biology, is the safest method which is likely to lead to improvement in the productive capacity of our existing forest soils and to bring many extensive areas at present considered doubtful or unsuitable for tree growth into a fit state for afforestation.

Nor is the æsthetic aspect of forestry being neglected. The provision of future national forest parks is being kept in mind. The forests are still too young to permit of general access by the public, but in due course suitable areas will be opened up for health and recreational purposes. The Commissioners are co-operating with the Director and staff of the Royal Botanic Gardens at Kew in the formation of a new arboretum at Bedgebury near Goudhurst in Kent, away from the smoke and fumes of London. The arboretum is being laid out to show fine specimen trees singly and in groups. At Benmore in Argyllshire, an estate comprising 10,200 acres was gifted to the Forestry Commission in 1925 by Mr. Harry George Younger, and three years later he generously augmented his gift of land by creating a trust known as the Younger Benmore Trust, the income from which is used for the maintenance of the gardens and grounds, which are now open to the public. The gardens, by arrangement with H.M. Office of Works, have been placed under the control of the Regius Keeper of the Royal Botanic Garden, Edinburgh. The rest of the estate is administered by the Forestry Commissioners.

Forest worker's holdings, which were not part of the original programme of the Commission, were started in 1924 as a scheme of land settlement, but since 1931, the creation of new holdings has been restricted to such as are essential to the proper working of the forest. The number of forest workers resident on the holdings is 1,176, and including their families there is a total residence on the holdings of 4,978. Figures compiled from careful records show that, as a whole, the holders, most of whom started with no capital, now own live stock to the value of £43,173.

In co-operation with the Ministry of Labour, instructional centres and camps have been established, about twenty-eight in all, near land belonging to the Commissioners. Each centre accommodates about two hundred men, who are drawn from areas of heavy and prolonged unemployment, and are given a three months' training course to develop physical fitness. The type of manual work provided for the trainees consists mainly in clearing sites for forest roads, quarrying stone and laying road foundations, the building of bridges and culverts, land drainage, scrub clearing and grubbing roots—constructive work which will be of permanent value.

A series of four sketch maps illustrating the progress of the acquisition of forest units at the end of each five years from 1919 until 1934, shows an increase from eighteen units in 1919, to one hundred and eighty-six units in 1934.

Under the exceptionally difficult conditions, especially in rural areas, which have existed since the War, it is not surprising to learn that afforestation by private owners has not come up to the expectations of the Acland Committee Report. The Commissioners have done their best to come as near as possible, in the circumstances, to the provisions for the acquisition of land laid down in that report, but much leeway in both State and private effort still remains to be made up, and

surely now is the time when the State can, with present and future advantage, speed up the development of forests and forestry.

In presenting this review of their first fifteen years' work, the Forestry Commissioners are able to show a creditable record of achievement. The foundation for the future development of State forestry has been well laid and, as time goes on, we shall begin to reap the increasing benefits, industrial, economic and social which cannot fail to follow a wise forest policy. This report is of outstanding national importance, and the reader who is interested in the development of forest policy in Great Britain will, we feel sure, conclude that the interests of the country in this respect are in safe keeping.

Inductance, Capacitance and Frequency Measurement

The Measurement of Inductance, Capacitance and Frequency

By Albert Campbell and Dr. Ernest C. Childs. Pp. xxiv+488. (London: Macmillan and Co., Ltd., 1935.) 30*s*. net.

WHEN we consider that all matter is composed of electric ions which are in constant oscillation, it is evident that the study and measurement of electrical oscillations must always remain a leading feature of physical investigations, and the measurement of inductance, capacitance and frequency over an enormously large range must form a major part of laboratory testing. But this wide range of frequency, from a few cycles per second to the hundreds of acoustic measurements, the millions of wireless signalling, the billions of thermal and luminous radiation, and the trillions of X-rays, calls for constant development of such methods as different sections of the frequency range are utilised, so that the number of methods of measurement is already legion and must become even larger in the future.

However familiar the laboratory worker may be with certain methods, he is unlikely to select the method which is most suitable for any particular purpose, without a comprehensive survey of all the various methods and devices now available; and a single volume in which they are described and critically compared has long been needed. Mr. Campbell's inventiveness and long experience in this sphere renders him specially qualified to write such a volume, and in conjunction with Dr. Childs he has produced a book which should be at hand in every test room, and is likely to remain the standard work on the subject for many years to come.

Those who are familiar with Mr. Campbell's articles in the "Dictionary of Applied Physics" will recognise the simple concise manner in which the various methods and instruments are described; all essential theory being included without redundant detail or complexity. These articles form the nucleus of the present volume; but the sections dealing with vibration galvanometers and inductance and capacitance measurements have been greatly expanded, and the value of the book has been greatly enhanced by the addition of a long chapter on frequency measurement, and, especially, by four chapters on alternating current potentiometers. The latter addition is especially welcome, as, in spite of the great convenience, universality and range of alternating current potentiometers, they have hitherto been little used, and it is to be hoped that this account of them and indication of their many applications will conduce to their wider appreciation and use.

A brief opening chapter on alternating current theory is followed by one on sources of current which describes various forms of alternators, interrupters, microphone and tuning fork hummers, arc and valve oscillators, and frequency stabilisers. Chapter iii, on measuring and detecting instruments, includes electrodynamometers, alternating current galvanometers, thermal instruments and telephones, amplifiers, rectifiers and valve-voltmeters; while Chapter iv, on vibration galvanometers, describes practically all the types which have been devised, with their theory and application. Resistances for use in inductance measurements are dealt with in Chapter v, which includes all the best-known types of anti-inductive resistances, including tubular forms, but reference might have been made to the extremely valuable tubular resistance of A. E. Moore which is the only perfectly non-inductive one.

Inductance measurements occupy Chapters vi–xiv, commencing with the calculation of inductances both by rigid methods and the most convenient approximate formulæ, and passing on to the construction of mutual inductances, including of course the valuable Campbell types of absolute standards and variable inductors; transformers; construction of fixed and variable self-inductors; electrical networks and bridges; measurement of mutual inductance; testing of transformers; measurement of self-inductance and

effective resistance; and inductance of measuring instruments.

Condensers and capacitance measurement are considered in Chapters xv–xviii, dealing respectively with theory; dielective constant and power loss; construction of condensers; and methods of measurement. This portion of the work contains much useful information concerning the properties of dielectrics.

Chapter xix, on the measurement of frequency, covers a very wide field from counters and synchronous motors, and standard frequency control to stroboscopes, resonance and deflectional frequency meters, bridge methods and wave meters.

The remaining four chapters, xx–xxiii, on alternating current potentiometers, deal respectively with their general principles and history; theory of phase splitters; description of various alternating current potentiometers; and uses of alternating current potentiometers. As above stated, these form one of the most novel and important features of the book.

The whole volume is attractively got up and clearly illustrated, and a short bibliography of the most important papers on each subject is included at the end of each section, as well as an appendix of books of reference. Copious references to special papers are provided in the text. C. V. D.

A Landmark in the Study of Optical Activity

Optical Rotatory Power

By Prof. T. Martin Lowry. (Text Books of Physical Chemistry.) Pp. xiii+483. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 30*s*. net.

IN view of Prof. T. M. Lowry's remarkable industry as an investigator, it is a matter for further admiration that he should be able to produce, as a sort of by-product, this extensive work on optical activity. Nothing of an equally original character has hitherto appeared in book form in English; and its arrival is very welcome on that account, as also because it is an attempt to give a conspectus of the whole field, including, happily, the historical development of the subject.

The first of the four parts into which the book is divided is general in character, and deals briefly with the phenomena leading up to the discovery of the polarisation of light by reflection from glass; the discovery of the rotation of the plane of polarisation in quartz; with Fresnel's views; with the work of Pasteur; and with rotatory dispersion, circular dichroism and magnetic rotatory power.

Part ii, covering nearly one hundred pages, is devoted to a description of the apparatus used in various kinds of polarimetric work, and will doubtless be found very useful in giving a clear idea of the principles underlying the operation of many instruments presently in use; but inexperienced readers may occasionally be a little misled by the fact that the two Nicol prisms, which form part of much of such apparatus, are usually, or always, shown in the parallel position, whereas in fact their action depends upon their principal planes being almost at right angles.

In Part iii are discussed a number of important topics, such as muta-rotation, optical superposition, anomalous dispersion, induced dissymmetry and circular dichroism; whilst Part iv deals with theoretical considerations, too various to specify, but concerned largely with electrons and circular dichroism.

In spite of the wide range of the work, it may, nevertheless, scarcely be described as a textbook. It is, rather, a comprehensive monograph; since it deals so largely with the views and work of the author himself, or with such views and work as he happens to approve of. This is not said in disparagement: rather the contrary, since a description of an author's own views is likely to be more stimulating than would be his description of the views of others. But it is surprising that Alexander McKenzie's work, notably in regard to the Walden inversion, to asymmetric synthesis and to asymmetric induction should receive no mention at all.

In the first edition of a book which contains so much matter, it would scarcely be possible altogether to avoid mistakes. There are, here, at least two which might easily be very misleading. On p. 330 is given a diagram, taken from one of Winther's papers, which professes to represent the specific rotation of nicotine in different solvents. In fact, however, it represents that of ethyl tartrate, the mistake being due to two blocks in the original publication having been interchanged. The correct diagram is given in *Z. phys. Chem.*, 60, 652; 1907. Fig. 48 also, on p. 154, which purports to represent Cotton's results, although given originally by Cotton himself (*Ann. Chim. phys.*, [7], 8, 408; 1896), is also incorrect. As Cotton pointed out in a later paper (*J. Phys.*, [3], 7, 84; 1898) the curve of ellipticities shown here ought to be inverted.

Generally speaking, however, those parts of the book dealing with facts, either regarding apparatus or experimental results, will be found clear and useful. The theoretical parts, at least to the present reviewer, appear much less convincing and satisfactory. They are, certainly, altogether in the modern style, but are really a kind of make-believe, a superficial plausibility—little more than casuistry. Thus, although it is some sixty-three years since Arndtsen first suggested that what is arbitrarily termed 'anomalous' rotation-dispersion is due to the presence of isomers, and this is the popular view to-day, no progress whatever has been made in identifying or isolating these highly elusive isomers, except by showing that a large number of other compounds also exhibit the same phenomenon. The idea, however, by constant iteration, appears to be regarded, popularly, as proved, although the argument amounts merely to this: "Why does this compound—tartaric acid for example—exhibit anomalous rotation-dispersion?" "Because it contains two isomers of opposite and different dispersion." "How do you know that it contains two isomers of opposite and different dispersion?" "Because it exhibits anomalous rotation-dispersion." It is the same kind of argument that Lavoisier exposed very devastatingly: "Why does a substance burn?" "Because it contains phlogiston." "How do you know it contains phlogiston?" "Because it burns."

Similar criticism could easily be directed against most of the theoretical parts of the book. Optical superposition is referred to in various places, but none of the work described can give a definitive solution of the problem, whilst the only work on record which, from the theoretical point of view, is sound, is not mentioned at all.

In regard to solvent influence on rotation, a numerical parallelism can be instituted in several cases between rotation and dipole moment. The large number of exceptions are then, quite arbitrarily, attributed to some other cause, such as association, without any kind of proof that association—if it occurs at all, which is doubtful—does affect rotation. The causes are mere *Dei ex Machina*.

Two other examples will show how facile is modern argumentation. If, in the substance $\begin{matrix}CH_3\\C_2H_5\end{matrix}\!\!>\!CXY$, the CH_3 group is replaced by a C_2H_5 group, the resulting product will be inactive, but, according to Prof. Lowry (p. 303), if the CH_3 is replaced by C_3H_7 "It is generally admitted that the sign of the rotation will be reversed", and an argument is actually founded on this exceedingly slender basis. There does not seem to be a particle more than a 1 : 1 chance of this general admission being true (the result would probably vary with the nature of the groups XY, the solvent, colour of light, concentration and temperature); and arguments, in any event, ought to be founded, not on general admissions, but on experimental facts, which, here, are lacking. Again on p. 364, Prof. Lowry approves Boys's attempts to calculate certain rotations, "in spite of the impossible character of the assumptions made in reference to the more complex radicals". It is to be hoped that conclusions based upon impossible assumptions will not become too common.

In spite of such criticisms, however, the book is a notable addition to the literature of optical activity: a production of which the author and the publishers may well be proud.

T. S. PATTERSON.

Experimental Linguistics

L'Analisi elettrocustica del linguaggio

Per Agostino Gemelli e Giuseppina Pastori. (Pubblicazioni della Università Cattolica del Sacro Cuore, Serie 6: Scienze biologiche, Vol. 7.) 1: Testo. Pp. xxviii+250. 2: Atlante della tavole. Pp. iii+88 plates. (Milano: Società Editrice "Vita e Pensiero", 1934.) 2 vols., 75 lire.

FOR the purpose of studying spoken language from the linguistic point of view, the authors obtained registrations on strips of sensitised paper by means of a microphone connected to a wire-loop oscillograph (Duddell). One of the problems handled is the nature of the vowels. A curve of *ah*, for example, is divided by the authors into 75 vibratory bits of similar, but not identical, character occurring in immediate succession. To obtain a numerical expression for the curve in a vibratory bit two methods are used. In one of them the form of the wave—the vibration profile—is expressed as the sum of a series of sinusoids with frequencies in the relations 1, 2, 3, . . . whereby the number 1 corresponds to the number of times with which the entire length of the wave could be repeated in 1 sec. (Fourier polynomial, harmonic series). With the other method (Vercelli) the wave form is expressed as the sum of a set of sinusoids in the series 1, .., .., ... in which the number 1 has the same meaning as in the harmonic series and the other numbers may stand in any relations whatever to the first one.

The results with both methods agree in having

very small values for the first member; in all other respects the results disagree completely. The harmonic analysis showed strong amplitudes occurring in groups and small amplitudes everywhere else. The Vercelli analysis showed a few strong amplitudes that were not grouped; these belonged to frequencies not harmonic to the first member. The authors do not attempt to explain the complete discrepancy or to interpret either set of results. The fact that every vibration profile consists of a wave movement that begins strong and fades rapidly to zero is quite overlooked. A prime characteristic of such a wave is its factor of decrement. Neither of the two series provides for an expression of the decrement. It shows itself by modifying the values for the amplitudes, by producing amplitudes for all members and by adding a meaningless constant. Vibrations with decrements may be aroused by suddenly releasing a spring, by uncorking a bottle, by snapping the thumb out of the mouth or by suddenly releasing a pressure of the air at the glottis with the mouth open. The curve of the vibration from the spring is a slowly fading one with smooth waves. That from the bottle is a rapidly fading one with smooth waves. That from the mouth in the last two cases is exactly like a curve of a vibratory bit in a vowel; the sound is, in fact, a real vowel consisting of only one bit.

The results of Fourier and Vercelli analyses of various vowels are given. The authors reach the conclusion that the specific nature of a vowel vibration is not the result of the presence of a specific frequency or frequencies (Willis-Helmholtz-Hermann theory of formants) or of specific relations among the frequencies (Lloyd), but of a special complex of elements to which they apply the term 'specific character'. The specific profile is the expression of the specific character. Just what elements go to produce the specific characters remain unstated. This view is identical with that expressed in the profile theory, according to which vibratory bits are perceived as unanalysed profiles (NATURE, 130, 275; 1932).

By an extension of the term, it becomes possible to speak of the profile of a whole vowel, of a word, of a phrase, etc. Just as a vibratory bit is perceived as a profile without analysis, so a whole vowel is perceived as a profile without analysis into vibratory bits, a word as a profile without analysis into speech sounds, a phrase as a profile without analysis into words, etc. Interesting in this connexion is the fact that when speech vibrations are amplified sufficiently to be perceived by the sense of touch (Gault's teletactor) the tip of the finger recognises the various vowels, consonants, words and phrases by their vibration profiles.

The physical vibrations are expressions of what the speaker 'intended to say'. The ultimate unit of inner speech—that is, of language—is termed a 'phoneme'. This is defined by the authors as "any sound or noise used in language that cannot be divided into other elements of language but only into vibratory phenomena". The phonemes include vowels, semi-vowels and consonants. It is to be clearly understood that these are inner (or psychic) units, and not physical ones. The word *luna*, for example, is assumed to be composed of four speech sound phonemes indicated by the letters *l*, *u*, *n*, *a*. The authors divide the registration of this word into four portions and consider each portion as the expression of one phoneme. According to the authors, the word consists both psychically and physically of a succession of four portions. The registration, however, shows that the characteristics of the wave forms present during the portion assigned to *l* are present also in the waves of the first part of the portion assigned to *u*, and, conversely, characteristics of the waves in the portion assigned to *u* can be traced in the waves of the last part of the portion assigned to *l*. This indicates that the phonemes *l* and *u* were overlapped before they were expressed in physical speech. The phenomenon of overlapping occurs everywhere in the registrations. The word *luna* is to be considered as the sum of the four speech sound phonemes occurring not in succession but with overlapping. The registration of the word must be taken as a whole; it cannot be divided into a succession of sounds.

Fifty years ago, Rousselot sought to overcome the impossibility of analysing speech by listening to it. To register it on a phonograph would have been of no use, because all he could have done with his registrations would have been to listen to them again. The oscillograph and the sound film had not been invented. The method that he devised consisted in placing a cuplike receiver over the mouth and the end of a tube in a nostril and conducting the changes in the breath issuing from the mouth and nose to membranes the movements of which were registered on a moving surface. His registrations were of the mass movements of air that constitute macrophonic speech (see NATURE, 132, 138; 1933). Macrophonic speech produces microphonic speech by arousing vibrations in the vocal cavities. The authors of this work have contributed to the foundation of linguistics as an exact science by analyses of microphonic speech. They make use of comparisons with macrophonic registrations. With these and some other methods linguistics begins to become a science based on numbers.

E. W. SCRIPTURE.

Weather Parallels and Paradoxes

(1) Through the Weather House:
or, The Wind, the Rain, and Six Hundred Miles Above. By R. A. Watson Watt. Pp. xi+192+8 plates. (London: Peter Davies, Ltd., 1935.) 7*s*. 6*d*. net.

(2) Weather Proverbs and Paradoxes
By Dr. W. J. Humphreys. Second edition. Pp. xii+126+16 plates. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1934.) 9*s*.

(1) EARLY in 1934, Mr. Watson Watt gave a series of broadcast talks on weather which attracted considerable interest from the novelty of the treatment and the vividness of the imagery. These talks have now been published in a very readable book, illustrated by some good cloud pictures. The "Weather House" as pictured in the frontispiece is a super-sky-scraper of ultra-modern design, with a hundred stories each six miles high, fitted with all modern conveniences in the form of electric lighting, heating and decoration, and all supplied by 'wireless'.

The matter is the familiar matter of any popular textbook on meteorology, with a few additions from the author's special sphere of research, but the exposition is very clear and is certainly helped by the analogies with domestic appliances, though to the meteorologist these become a little tedious at times. Water in various forms naturally plays a large part—"Damp in the Weather House", "Cloud-Weaving", and "The Water Supply", but the author is most at home in the upper stories and his treatment of atmospheric electricity, the ionosphere, ozone and meteors ("Throwing Stones at the Weather House") is especially good. Unusual also is his account of the organisation of synoptic forecasting in a meteorological office—"The Servants' Quarters"—for when looking at a weather map one is apt to forget, for example, the "comrade in Moscow stamping through the snow" to read his instruments. There is much sound sense if little enthusiasm in the short chapters on "Saws, Saints and Sages", "Controlling the Weather", and "Further Outlook— ?"; the last chapter in fact is definitely pessimistic; but the warning is timely.

(2) Weather proverbs are many and varied; some are useless but others contain a grain of truth. Prof. Humphreys sets out to rescue the latter from their undesirable companions, and to clothe them in a garb of logic. The result is an attractive essay in popular science, though not everyone would agree that all the selections are justified, and a few of the explanations seem a little far-fetched. The belief that a grey morning sky betokens a fine day may be capable of explanation, but a 'grey' sky is presumably an overcast sky, and in Great Britain the observations of Spencer Russell have shown that an overcast sky at sunrise is about as likely to be followed by rain before sunset as is a red morning sky. One proverb with at least as much justification as the grey sky at morning has been omitted from the chosen company, namely:

"Rain before seven
Lift before eleven."

We should like to see more of these proverbs subjected to the test of observation. A few of them are probably true of North America, but will not bear transplanting to Great Britain. Some of the "paradoxes" of part 2 are rather forced, but a few provide interesting examples of the curious working of physical laws. On the whole, the selection, like that of the proverbs, is good, while there can be no two opinions about the excellence of the sixteen plates.

Spektroskopie
Von Prof. Dr. Karl Wilh. Meissner. (Sammlung Goschen, Band 1091.) Pp. 180. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) 1.62 gold marks.

THIS little book is not intended for spectroscopists, but rather for non-specialised students of physics who need a straightforward elementary account of spectroscopic principles and methods. The scope is wide, scarcely any major branch of the subject escaping at least brief notice, the presentation orderly and clear, and the diagrams astonishingly numerous in relation to the low price of the book. The emphasis is laid, on the whole, on the instrumental side of the subject, and the explanations of the various types of high-resolution spectroscope are particularly well done.

It is, in fact, just the right kind of book for an honours student of physics who wishes to read some German, for, though simple in style and in matter, it is yet sufficiently informative to be read for its own sake and not merely for reading practice.

Numerical Studies in Differential Equations

By Prof. H. Levy and E. A. Baggott. Vol. 1. Pp. viii+238. (London: Watts and Co., 1934.) 12*s*. 6*d*. net.

THE teaching of differential equations in English universities usually follows an unsatisfactory middle path. General theory is omitted as too difficult, while numerical methods are considered unworthy of notice. In consequence, the student is made acquainted with only a small number of special types of equation and is left to believe that nothing can be discovered about the solutions of other types. A reading of even the first two chapters of this book by Prof. Levy and Mr. Baggott would alter the outlook of many such students completely. The second chapter, on graphical methods of solution, would form an excellent addendum to a course in curve-tracing, the two together being used to illuminate wide tracts of algebra, geometry, and the calculus.

The main portion of the book is concerned with the numerical solutions of ordinary differential equations of the first and higher orders, consideration of partial differential equations being reserved for the second volume. Many methods, some well-known, some apparently new, are given and their degrees of accuracy are discussed and compared. It is impossible to estimate the value of these methods without long experience in their use, but they appear to be sufficient for most purposes and some of them are of considerable theoretical interest.

There are a few obscurities which might have been removed by careful revision, and a larger number of examples for practice might well have been included. These are minor criticisms, and detract but little from the value of a book which should be in the hands of all who are engaged in research in applied mathematics and of all who are interested in the improvement of mathematical teaching.

Faune de France

28: Diptères (Brachycères), (Muscidae Acalypterae et Scatophagidae). Par E. Séguy. (Fédération française des Sociétés naturelles: Office central de faunistique.) Pp. iii+832+27 plates. (Paris: Paul Lechevalier et fils, 1934.) 300 francs.

THIS systematic survey of the acalyptrate muscid flies testifies to the skill and industry of its author. Numerous keys in the form of tables, short clear descriptions with remarks on differential characters of the families, genera and species, and 903 text figures in addition to 27 plates facilitate, so far as is possible, the identification of these flies. Under each species is a note of the area of distribution and, where known, the period of occurrence of the imago. In those species, the larvæ of which are phytophagous or parasitic, the food-plant or host is stated. In nine pages is a summary of the bionomics of these lower muscids, and at the end of the volume are alphabetical lists of their animal hosts, with their respective parasites and commensals, and of the plants and their respective muscid parasites. A good bibliography and systematic index complete this very satisfactory work.

Wild Flowers of the Great Dominions of the British Empire

By The Lady Rockley. Pp. xii+380+32 plates. (London: Macmillan and Co., Ltd., 1935.) 16*s*. net.

THE non-botanical traveller, who is unable to use a technical flora, often feels in need of a book which will help him to appreciate the vegetation of the various lands he visits and which will indicate what floral treasures are especially worth his notice in particular areas. Lady Rockley, in the present volume, has given the traveller in the British Dominions just such a guide, and her book will undoubtedly appeal to a large public of flower-lovers.

The countries dealt with include Canada and Newfoundland, Australia, New Zealand, South Africa, Rhodesia and Kenya. An immense amount of information has been packed into Lady Rockley's attractively written pages, and the coloured illustrations, many of them painted by the author during her travels, with no thought of publication, add greatly to the value of the volume.

Birth Control and its Opponents

By Frank W. White. Pp. xi+164. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 3*s*. 6*d*. net.

IN this little book, the facts of population and over-population, and the wastage of human life that results under uncontrolled conditions of mass reproduction, are first marshalled. The regulation of births and limitation of population by artificial methods are then detailed, and the benefits likely to arise therefrom stated. Finally, the arguments of the opposition to artificial methods for the control of pregnancy are set out and examined.

No better brief and popular summary of the subject of birth control could be found than is given here, and as Lord Horder says in his foreword, Dr. White deals patiently and convincingly with the arguments that are advanced against it by a small section of the community. It may be hoped that a growing public opinion will in time convert religious authority, from which the chief opposition at present emanates.

R. T. H.

A Flower Book for the Pocket

By Prof. Macgregor Skene. Pp. 380. (London: Oxford University Press, 1935.) 7*s*. 6*d*. net.

THIS pocket-book is meant for the layman and also as a first 'flora' for use in schools. 501 flowering plants are illustrated in coloured plates, most of which are reproductions of the paintings by the late Miss C. G. Trower. The rest, together with 28 black and white drawings of grasses, are the work of Miss Ruth Weston. To our knowledge, there is no other book at the price which is so profusely and well illustrated. So far as is possible, technical terms have been avoided. The key includes all British families, and the sequence follows that of the standard British 'floras'. It has been compiled by Prof. Macgregor Skene. Thus, the book has the stamp of authority, is well produced and, unlike many 'floras', is easy to follow. This, together with its low price, should ensure the book of the success that it clearly deserves.

Some Aspects of the Polar Regions*

By Prof. F. Debenham

THERE is now a vast literature of the polar regions, both north and south, but the proportion of those books and papers which deal with the subject on a broad basis is very small, and is certainly not easily accessible. In many of these books we are invited to conjure up the sensations of the polar explorer, to feel his frost-bites, to savour his pemmican, to glory in his pack-ice and his glaciers, even to die his death. Not the least part of our interest in polar work is due to these invitations so graphically offered to us in text and illustration. Much more rare is it to find a polar explorer viewing his territory as a whole, and trying to fit it into the scheme of the world in general. In a word, we are rather encouraged to regard the polar regions as places apart, extraneous to the real comity of the world. We will first consider the kind of value of the polar regions which appeals most quickly to the public.

TRADE AND TRADE ROUTES

There is little need to sketch the history of man's attempts to achieve economic gain from the polar regions. From the days when Martin Frobisher attempted to find a quick route westwards to the Spice Islands *via* the North-West, and Barents a similar route eastward, down to more recent times when, though the routes had lost value, the products of hunting, fishing and mining attracted venturers with similar motives, the chief aim of promoters of polar expeditions has been one of ultimate gain. It is true that many of the leaders of the expeditions had little care for the commercial side, but the money that sent them forth was, in the greater number of cases, put out in the time-honoured hope of all ages that it would bring in interest in some form or another.

There is certainly such a thing as the romance of commerce in the North, for most of its industries have something peculiar and unusual about them. We may instance the cryolite mines of Ivigtut in Greenland—a strange mineral found in quantity nowhere else in the world, which however is almost essential to the large-scale production of aluminium. Again, until recently a large proportion of the ivory for use in northern China did not come from the present-day elephants of the rain forest belt of Asia, but from the mammoths of primeval times the tusks of which lay for many thousands of years buried in the mud of the great Siberian rivers flowing into the Arctic Ocean.

Romantic or not, the story of Arctic trade has a grim and melancholy side, in that several of its most promising ventures have died a slow and painful death by reason of the cupidity of man and his unwillingness to co-operate either to preserve life or even to preserve it sufficiently for his own benefit. The history of the whaling industry in the Arctic is an instance of this incapacity of man to co-operate in taking the most common-sense measures to cherish a valuable industry. There is every reason to hope that the day of non-co-operation has passed and that a similar fate to whaling in the Antarctic will not take place, for it is probably common knowledge that many bodies, in which we may include the League of Nations, the Norwegian whalers themselves and the "Discovery" Committee of the British Government, are at work in their various spheres to prevent any extermination of the southern whales, and at the same time to regularise an industry which, even in these days of synthetic materials, still has its vital uses to man. How large that industry now is may be gathered from the fact that the annual catch of whales in the southern seas is about 20,000: how mindful it now is of its own future may be seen from the fact that whereas the average whale used to provide only 60 or 70 barrels of oil, it is now made to yield nearly 120 barrels of oil besides other products.

These products of hunting, fishing and mining were the natural resources of the North and were the first to be exploited, but quite recently a new factor in the commercial aspect of the North has come to the forefront. With the progress of long-distance aviation and the simple application of the principle of great-circle navigation, the idea of using these northern latitudes for passenger and even freight routes in the air has become not only prominent but also almost insistent.

Owing to the misleading projections on which most of our maps are constructed, it is not usually recognised that the most direct route between, say, Berlin and Montreal, or Glasgow and Winnipeg, is over Greenland, but it is so. It seems to be only a matter of time and the inevitable improvement of aeroplanes before some use is made of a route which was first investigated as to conditions by the Watkins Expedition of 1930.

Summing up this economic aspect of the polar regions, the warning may be given that even now,

* From the presidential address to Section E (Geography) of the British Association, delivered at Norwich on September 5.

as in the past, there is a tendency to ascribe potential wealth merely on account of the existence of land masses. Indeed, even explorers, who should have known better, have been heard to speak glibly of the untapped mineral resources of the polar lands, neglecting to tell their public that though these resources undoubtedly exist, they are for the most part covered by thick ice sheets or rendered inaccessible by topography, or climate, or both. Quite a brief calculation, for example, would show that the proportion of the Antarctic continent available to the prospector and miner is to the total land mass in somewhat the same proportion as the area of the city of Norwich is to the whole of England.

Although the land can have little value in the Antarctic there is, strangely enough, a natural resource in the air which, however fantastic it may appear to us, may yet have a substantial interest for our descendants. It is a truism of science that we draw practically all our sources of power from the sun, either indirectly in the form of coal and oil, or directly in the form of water-power, in which the sun by evaporation has raised water to a height from which gravity, suitably used, returns power to us. Now, although water is one of the things of which there is a great scarcity in the polar regions, and the movement of ice masses can scarcely be handled by engineers, yet meteorological processes are doing the same thing for air, raising masses of air in one area which sink down in another, and so provide a source of power less tangible but just as real as that of water in a highland lake. The persistence, the strength and the frequency of the Antarctic blizzards compels anyone who has experienced them to feel that here is a vast source of power as yet untapped. May we be permitted to forecast that some day the miseries of the storm-bound parties of Mawson's expedition, when for a whole year the wind averaged gale force, may be atoned for by our descendants making use of this power when coal is scarce and oil exhausted, while all the water-power in the temperate regions is fully harnessed? Compare the power in the well-known falls of Niagara, about 6,000 tons of water falling per second, with the power in the little-known Adélie Land, where an air river of at least 50 miles in width and probably some hundreds of feet in depth is moving outwards from the plateau at an average velocity of 50 miles per hour, or about 70 ft. per second for most of the year.

The Poles as Sanatoria

We pass now from the economic aspect of our subject to some others which have less appeal to the man in the street, but which must never be omitted in any consideration of a region by a geographer.

The consideration of the polar regions as a holiday resort for the citizens of crowded lands leads us naturally to a far greater value which has as yet scarcely been considered by civilisation, a value which indeed may yet prove to be more worthy of study than all those we have so far mentioned. It is reasonable to suppose that when some far-travelled medical man comes to write a book on the geography of diseases, we shall be able to come by a clear idea of where health is best to be sought. The ordinary geographer would, however, even now be able to make something of an essay on the distribution of healthiness over the world. Leaving out cities as unnatural, or at least unhealthy aggregations of humans, he would at once say that, on the whole, the most unhealthy parts of the world are in the tropics, though he would have to have a special category for tropical and oceanic islands, which as a rule are decidedly healthy. He would, if he were wise, consider that the steppe deserts are healthy zones; but probably he would decide that the temperate zone as a whole, provided it is not too far from the sea, is the healthiest belt of the world for man. It is almost certain that he would entirely forget that the polar regions are definitely the most healthy segments of the earth's surface, for the simple reason that the ordinary disease-bearers, whether they be rodents or insects or minute bacilli, find the conditions either impossible for existence or inhibitive.

But we are not concerned here so much with the healthiness of the zone as with its value from a remedial point of view, for we are certainly not going to migrate in millions to the Arctic just because we cannot there contract the diseases of our own lands. But what we may well pay attention to is the corollary to that healthiness, namely that many, though not all, of the diseases contracted in temperate climates can be cured by residence in the polar regions.

I am aware that it is more than dangerous, indeed provocative in the highest degree, for anyone outside the medical faculty to say how far special diseases are curable by residence in a pure air and a cold one. It seems, however, from the experience of sanatoria in the Alps, etc., that it is the sufferers from pulmonary diseases who are most likely to get benefit from such residence. The question will at once be asked as to what the polar regions can supply which is not already obtainable, say, in the Alps. For an answer to this question we must look to the medical men; but it does seem likely that residence in a vast territory free from germs or the conditions for their transport must, *prima facie*, be better than

residence in an alpine region which is surrounded by, and is merely above, zones teeming with possibilities of disease. If this thesis is correct, and it is one which a small period of research could easily confirm or refute, then surely we are neglecting an aspect of the polar regions which is of major importance to mankind, more valuable than all the industries they will ever support.

To test the value of the suggestion there is needed research and experiment, most appropriately to be carried out under the auspices of one of those international bodies such as the Rockefeller Foundation, which has already done so much for remedial medicine. For assistance in carrying out this research there is needed the sympathy of Governments, especially that of Norway, in the care of which is the most promising territory in the Arctic for that purpose, namely, Svalbard or Spitsbergen.

Let us remember too, before we allow hands of horror to be raised at the expense of such research, that in the past sums of money have been spent in Spitsbergen itself for the erection of an airship hangar and provision of the airship itself for a few hours' flight to the Pole, which would be sufficient to erect a hospital and run it for many years in an experiment which might be of permanent value to the world. We must be properly cautious as to results, but at the same time let us preserve our sense of proportion in the value to man of how we spend money in the polar regions. It is almost lamentable to consider the sums of money which have been spent in what may be understood by the term of 'stunt expeditions' and place those sums in contrast to the difficulty in raising money for such an object as this.

World Meteorology

We may now turn to yet another aspect of the polar regions, namely, the value to the scientific worker, both pure and applied, of the phenomena which are peculiar to these regions—phenomena well known to exist but the study of which is still in its early stages.

No doubt each science will claim the chief value of these phenomena for itself, but it is without any particular bias to one or the other that I should venture to place in the first rank the subject of meteorology as likely in the future to gain most by a prolonged and more intensive study in high latitudes.

We have spoken of the more or less permanent blizzards on parts of the Antarctic continent, and we ourselves live under the intermittent threat of depressions over Iceland. We can therefore, without much imagination, see that even if our weather is not actually manufactured at the polar ends of the world, it is profoundly affected by them. Meteorologists themselves have long been aware of this, and in two successive onslaughts, namely, in 1882 and in 1932, a determined effort was made to collect data simultaneously and widely within the precincts of the Arctic. The conclusions which have been drawn from these results are, as yet, scarcely in full circulation, but few meteorologists do not sigh for more and more data from the polar regions.

The phenomena of magnetism and aurora, which are somewhat akin to those of meteorology in that they occur in the atmosphere, are also best studied in high latitudes, where, too, the most promising investigations of the ionosphere seem to be likely.

Geology

When we come to the more earthly sciences, the immediate value to mankind is perhaps less evident. In the science of geology, for example, especially in its branch of tectonics, we cannot afford to do without close investigation of two segments of the earth comprising together nearly one tenth of the surface of the globe, and indeed the structure of the earth must become the more interesting the nearer one gets to its axis of rotation. The geologist has a hard task in lands where the rocks are usually buried beneath ice-caps, and has to be more than usually ready with the inspired guess than in other parts of the world.

In the Antarctic in particular, the highest of all continents and the most closely hidden, there are obviously to be found keys to some of the major problems of earth structure. We may instance only one which, no doubt, is occupying the attention of the geologists of the British Graham Land Expedition at the present moment, an expedition which hopes to press far to the south of the Archipelago where they are wintering, and to determine why and where the folded ranges of South America and Graham Land merge into or butt against the faulted escarpments of the Australian sector of the Antarctic.

It is in these larger problems of geology that the polar geologist can give most assistance to science. It is not long since the papers, in America at all events, were full of the discovery of coal beds by Admiral Byrd's geologist within 300 miles of the South Pole, and it was interesting to see that this discovery, which however was originally made by the Shackleton party in 1908, moved the Press public to exclamations of wonder that such things could be. Nevertheless the great controversies of whether the Poles have shifted in the past, and whether the continents are drifting, must draw their best evidence, both for and against, near the axis of the earth.

There has recently been published a fresh determination of the position of Sabine Island on the coast of north-east Greenland which tends to show that there is a definite westerly drift of some metres a year. Similar observations of Jan Mayen are even more startling. For these and other reasons, therefore, the geophysicist, whom we may call the mathematical cousin of the geologist, must keep his attention on the polar lands.

In the biological sciences also there are major problems to which the data of high latitudes alone can give the key, such as the drift of oceanic waters and the movements of plankton and their associated salts. The biologists, however, are already active in these investigations and need no spur to action. The many-sided character of the work of the "Discovery" Committee in this branch, over all the waters of the Antarctic ocean, is evidence of how carefully work on this aspect of the polar regions is being carried out.

The Spirit of Exploration

Lastly, I would consider yet another aspect of the polar regions, one which is perhaps more psychological than geographical, namely, their value as an outlet to that spirit of adventure and urge for exploration which has always been an attribute of man, and which will not diminish, however small the world may grow. It is a spirit which is at work equally in the small child climbing the apple tree, the schoolboy exploring his own small horizon, the undergraduate forming alpine clubs to scale the peaks of his own college, and the city clerk spending his week-ends living dangerously in sailing dinghy or on motor-bicycle.

In all of these there is a curious combination of an urge to test one's abilities and yet a desire for a secondary and more useful object in the deed itself, and this dual purpose is particularly evident in most of the young men who come to the Scott Polar Research Institute in Cambridge seeking ways in which to visit the Arctic.

Looking over the files of the geographical journals of the past few years, it is possible to see how many young men turn annually to the Arctic to satisfy their need for an outlet. If we include the official expeditions of Governments such as that of the Soviet, we shall find that every summer more than fifty groups of investigators go to the Arctic and, were it less expensive, the number would easily be trebled. Only a few of these groups go for purely scientific work, and still fewer for hunting alone. They are, in fact, as a rule imbued chiefly with a desire to see strange places and endure strange things, and only in a secondary way to bring back useful results. There has been of recent years a happy tendency for these groups to go and come back without undue fuss and publicity. I would suggest that this use of the Arctic as an outlet to a healthy and laudable desire is one which should not be left out of any assessment of values even though it must necessarily apply only to a small number of people.

Problems of Plant Pathology

THE presidential address of Mr. F. T. Brooks to Section K (Botany) of the British Association delivered at Norwich on September 9 began in very pleasing vein by describing some of the outstanding contributions to botany made in East Anglia, wherein Norwich is an ancient and important city. It is fitting that upon such an auspicious occasion, the president of the Section should remind his audience of the deep roots of botanical lore in Great Britain—roots which go back to the enthusiasm of the ardent amateur. One heard the names of W. H. Burrell, W. A. Nicholson and Dr. C. B. Plowright coupled, in the recital of botanical progress in Norfolk, with more professional workers such as Dr. M. C. Cooke, Sir W. J. Hooker, Prof. F. W. Oliver, Prof. E. J. Salisbury, and many others

The title of the address was "Some Aspects of Plant Pathology", and after showing that Norfolk farmers were among the first to realise the damage caused by disease, Mr. Brooks continued with a discussion of disease control by the use of resistant varieties of crop plants The bad effects of several wilt diseases, the leaf-curl disease of cotton, and black rust of wheat can now be controlled with considerable success by planting new varieties with resistant qualities, but it seems very unlikely that all diseases will be amenable to control by this method. New diseases are continually appearing, parasitic fungi are amongst the most variable of living organisms, and the capacity for disease resistance in the host is very much in the nature of a mutation. The nicely-adjusted equilibrium between parasite and host can be upset when the latter mutates towards resistance, but the fungus can also vary, to give a new physiological form capable of attacking the host mutant. Thus the biological race for

supremacy continues, and leads the plant pathologist to investigate further principles of control. Moreover, although the use of resistant host varieties is the most care-free method of disease control, it is not always the most efficacious. Bunt in wheat, for example, may be totally eliminated by simple fungicidal treatment of the seed before sowing, and infection of fruit trees with *Stereum purpureum* can be greatly minimised if the fungus is merely prevented from fructifying in and near the orchard. Such simple methods of plant hygiene should be part of the routine of every good gardener or farmer.

The ecological study of fungi is in its infancy, but the effect of climate on some diseases has been investigated. Prof. L. R. Jones and his colleagues at the Department of Plant Pathology, University of Wisconsin, have inquired into the effect of soil temperature upon disease incidence. Such parasites as *Urocystis cepulae*, for example, cannot infect the onion plant when the soil temperature rises above 29° C.[1]. Reinking[2] has shown that differing types of soil may play a controlling part in fungal attack, for the wilt disease of bananas in Central America is much more severe on sandy soils than on clay. High humidity may also inhibit parasitic attack, for the pink disease of rubber in Malaya only appears in the regions of highest rainfall It seems likely that in the near future it may be possible, by studying weather conditions, to advise growers of the appropriate times to spray potatoes and vines with *protective* fungicides against blight (*Phytophthora infestans*) and downy mildew (*Plasmopara viticola*) respectively. Such treatment, if performed thoroughly and as a matter of routine by all growers would, in all probability, entirely prevent the development of either disease.

The physiology of parasitism is now fairly well understood. The Tulasne brothers, de Bary, Brefeld, and Marshall Ward carried out much pioneer work, and the subject has been further interpreted by Prof. V. H. Blackman in more recent years. Mr. Brooks himself, in his specialist work on *Stereum purpureum*, has shown that the characteristic silvering of fruit tree foliage can be produced by injecting the stem of a healthy plant with non-living extracts of the fungus.

Our ancestors must have felt despondent and impotent when a sudden attack of black rust spread amongst their wheat, or when blight devastated their potatoes. We can scarcely wonder that they used the term 'magic' to account for such epidemics. Yet the glamour of magic is far surpassed by the fascinating results of investigations into the cause of such apparently spontaneous outbreaks. Mr. Brooks chose a sufficiently sensational example from the work of Mehta[3] in the lowlands of northern India. Uredospores of the fungus *Puccinia graminis* cannot withstand the very high temperatures of the plains in summer, yet the parasite appears year after year. The usual alternative host, *Berberis vulgaris*, here plays no part in the life-history. Infection comes each year from stray wheat plants growing above a height of 4,000 ft. in the Himalayas. Summer temperatures there are relatively moderate, and uredospores multiply normally, infecting the wheat crop of the hills during November and December. There is thus a continual source of spores, some of which are carried many hundreds of miles to the plains, by the prevailing north-westerly winds.

Research into physiological forms of parasitic fungi has been very active during the past ten years. More than a hundred such forms of *Puccinia graminis* are now known. The structure of each form is identical with that of all its fellows, but its host relations are different. Many other species of fungi have numerous physiological or biological forms, and it is obvious that the plant breeder is confronted by a very difficult task in his search for new host varieties which would be disease-resistant. The range of physiological forms does not seem to be standard, for types of *Puccinia triticina* and *P. glumarum* have been found at Cambridge, which do not appear on the Continent, and vice versa. This multiplicity of strains may even include non-pathogenic forms, as happens in the fungus *Fusarium cubense*, causing wilt disease of the banana[4]. Physiological forms may have arisen as a result of hybridisation, but some must also have arisen as gene mutants, since they appear in fungi such as *Puccinia glumarum* which are now, in all probability, entirely asexual. Mr. Brooks discountenances the idea of a 'bridging species', originally introduced by Marshall Ward to mark a host plant which was susceptible to distinct physiological strains of fungi from two further hosts which would not inter-infect. The bridging species would 'educate' the strains to infect their mutual hosts. A simpler explanation of Marshall Ward's results seems to lie in the large number of physiological forms which are now known to exist

The interaction of two or more fungi upon one another has a profound influence on plant pathology. A rotting log provides material for a succession of fungi, one after another, and each with its own particular taste for wood at a certain stage of decomposition. Similarly, a wheat plant normally resistant to *Puccinia glumarum* becomes susceptible to that fungus if attacked also by bunt (*Tilletia Caries*). More severe attacks of citrus trees follow infection by *Diplodia natalensis* and *Colletotrichum gloeosporioides* together than is the case with either organism alone[5].

Two organisms may also act in antagonism to one another Mr. Brooks's experiments on various species of *Stereum* show that oak wood attacked by *S. hirsutum* is not a suitable habitat for the more harmful *S. purpureum*. Fawcett and Lee[6] could not obtain any effect on the walnut tree by inoculating it with two parasitic fungi, each of proved pathogenicity. Millard and Taylor[7] also found that the organism causing common scab of potatoes lives in antagonism with a harmless species. The latter can be stimulated by the addition of organic matter to the soil, thus controlling the disease. Weindling[8] found that *Trichoderma lignorum*, a saprophytic fungus, produces a substance which is toxic to the hyphæ of *Rhizoctonia solani*, and, indeed, the depredations of the latter can be curtailed if spores of *T. lignorum* are added to the soil. The old saying "Set a thief to catch a thief" seems to be justified even in the realm of plant pathology.

Many disorders of plants appear for which no definite causal agent can be demonstrated. Certain crops, for example, do not make good growth if the element boron is absent from the soil. Heart-rot of sugar beet and mangolds seems to be due to such lack. Manganese deficiency is responsible for grey leaf or grey-speck of oats, whilst insufficient sulphur produces a serious disease of tea bushes in Nyasaland[9]. Several diseases of apples during storage are due to inordinately large amounts of carbon dioxide in the atmosphere. Brown heart is such a disease which can be overcome entirely by proper ventilation[10]. Injury by frost can also produce symptoms which are similar to those caused by some fungi. Canker of the larch tree, for example, may be caused either by frost, or by the depredations of *Dasyscypha*[11], both of which, in all probability, kill groups of active cambium cells.

Many of the researches outlined in Mr. Brooks's address have added to general botanical knowledge. It is often necessary for the pathologist to study a new phase of plant physiology, and alternatively, the physiologist can supply knowledge which is useful to the pathologist. The address was pre-eminently what we have come to desire of a sectional president—a point of view, emanating from his own specialist knowledge, and linking up with other branches comprised within his Section; the orientation of scattered facts into one harmonious whole.

[1] *J. Agric. Res*, **22**, 235, 1921.
[2] *Zentralbl. Bakt*, II, 91, 243, 1935
[3] *Indian J. Agric Sci.*, **3**, 939, 1933.
[4] Hansford, *Kew Bulletin*, p. 257; 1926.
[5] Fawcett, *Florida Agric. Exp. Sta. Ann. Rep*, 1912
[6] "Citrus Diseases and Their Control", p. 38, 1926.
[7] *Ann. App. Biol.*, **14**, 202; 1927.
[8] *Phytopath.*, **22**, 837, 1932
[9] Storey and Leach, *Ann. App. Biol*, **20**, 23, 1933.
[10] Kidd and West, Dept. Sci. and Ind. Res., Food Investig Board, Special Rept. No 12; 1923
[11] Day and Pearce, *Oxford Forestry Memoirs*, No. 16, 1934.

Speed*

By Prof. B. Melvill Jones

THE factors which have limited speed in the past can be grouped under two main heads, which may be roughly described by the words *Track* and *Power*. To move rapidly over the ground a smooth track is necessary in order to prevent the vehicle from bumping itself to pieces and from overturning, while power is required to overcome the internal friction of the mechanism and the head resistance which must always oppose motion, until we can arrange to do our travelling entirely outside the earth's atmosphere. These two factors, track and power, have alternately imposed limits on the speed of travel, one coming into operation whenever the other was temporarily removed.

The power to fly through the air at a height sufficient to be clear of the irregular air flow near the ground has at last disposed of the track problem as a factor limiting speed. For although the aeroplane has to lay its own track, in the sense that it has to expend power in doing something to the air in order to keep itself from falling, that power becomes continually less the greater the speed of flight and, of itself, is incapable of placing any limit on speed.

In the early days of flying, we were unable to separate the power essentially required for support—for track laying as we may describe it—from the power required merely to drag the aeroplane through the air. That this can now be done is due to the work of Prof. L. Prandtl, which was itself founded on some earlier work of that amazing mechanical genius, Dr. F. W. Lanchester. Looking back from our present point of view, Lanchester's insight into this very difficult problem seems almost miraculous, but he did not put his ideas into a form which appealed to the conventional man of science, and it was not until

* From a Friday evening discourse delivered before the Royal Institution on March 22.

they had been developed and given greater precision by Prandtl that they received any wide recognition.

The Lanchester-Prandtl calculations, as they are now called, may become very complicated, but the ideas behind them are not difficult to grasp. Everyone is familiar with the idea that when a body is projected suddenly in any direction the apparatus which does the projecting experiences a recoil. The rocket, for example, obtains the lifting force which sends it up by generating gas within itself and continually projecting the gas downwards, so that there is a continuous recoil which drives it upwards. The aeroplane obtains the lift which supports it in a manner similar to the rocket, except that it does not itself generate the gas which it projects downwards, but uses the air through which it is passing. The wings, driven through the air in an attitude slightly inclined to the direction in which they are moving, force down the air directly below them and suck down the air immediately above them, and in so doing experience the continuous recoil which keeps the aeroplane from falling. The air, however, forms a continuous medium around the aeroplane, and a downward current in one part implies an upward current in other parts, with outward cross currents below to relieve the congestion there, and inward cross currents above to fill the partial vacuum which would otherwise be formed.

These air movements can be calculated and, at the moment when the aeroplane is passing, they take the form shown in Fig. 1, where the aeroplane is seen from behind passing through the vertical

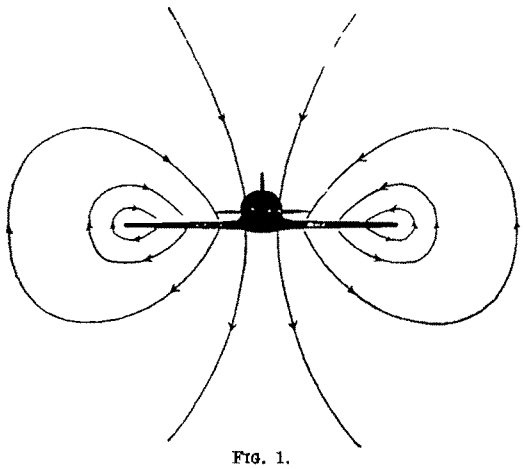

FIG. 1.

plane represented by the paper. The curved lines show the directions of flow; the distances between them being inversely proportional to the speed of flow. As soon as the aeroplane has passed, the flow pattern which is left behind begins to modify itself and ultimately takes the form shown in Fig. 2, which is simply the system of flow known as the *vortex pair*. These vortices, which are generally described as the *trailing vortices*, because they trail behind the aeroplane, remain in the air for several minutes after the aeroplane has passed, and are the cause of the bump which one feels on flying through the track of another aeroplane. It is by continually setting these air whirls, or vortices,

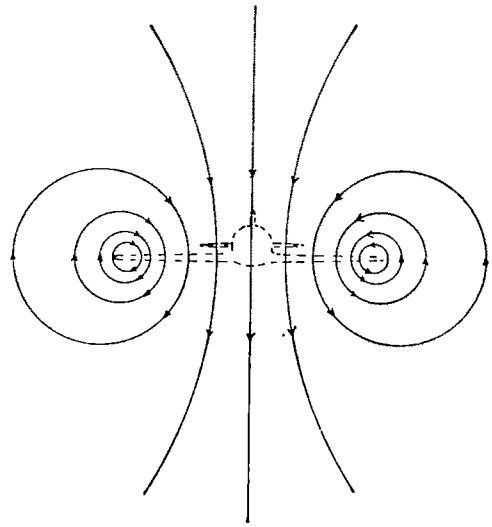

FIG. 2.

into motion, that the aeroplane supports itself, and it is because these whirls have to be continually created that power must be expended to obtain support. In effect, therefore, the aeroplane has to use some of its available power to create its own track, which is left behind in the air after it has passed.

The Lanchester-Prandtl calculations enable the power expended merely in supporting an aeroplane to be calculated with considerable accuracy; they show, for example, that the power required for this purpose, for every thousand pounds of weight of a modern civil transport aeroplane, ranges from about eight horse-power at one hundred miles per hour, to four horse-power at two hundred miles per hour, and is still less at higher speeds. Since the power actually available in civil aircraft of the present day, after allowing for losses in the screw propulsion, is of the order 60–70 horse-power per thousand pounds weight, it is clear that, although the aeroplane must pay for the elimination of the track problem by the expenditure of extra power, the amount of this extra power and the way in which it varies with change of speed are such as to place no final limits upon speed.

Having reached this conclusion, we are free to turn our whole attention to the remaining factor which does, and probably always will, limit speed: the resistance which has to be overcome merely to drag the aeroplane through the air.

Anyone who has ridden a bicycle must know that the air can exert a very considerable resistance to the passage of a man through it, even when the speed is so low as 15–20 miles per hour. Since the power required to overcome this resistance increases about eight-fold every time the speed is doubled, it is at once apparent that very great powers may be required at high speeds. The following table shows approximately the power required to push a man in a sitting posture through the air near the ground at various speeds.

Miles per hour	*Horse-power*
10	1/25
20	1/3
50	5
100	40
200	320
300	1,100
400	2,600

Such figures make it clear that unless head resistance can be very considerably reduced below these figures, economical transport at high speeds is impossible. Everyone nowadays knows that this reduction can be made by what is usually called *streamlining*, and our next task therefore must be to consider why streamlining is so effective in reducing head resistance.

We have now to begin from the point of view of the mathematicians who, some fifty years or more ago, studied the basic problems of fluid motion. They observed that water and air are very slippery substances, and they conceived the idea of studying an ideal fluid which they imagined to be absolutely slippery. Almost at once they reached the astonishing conclusion that solids of any shape whatever would be expected to move through such a fluid—if it could exist—without any resistance whatever. Impressed by this paradox they, for the most part, gave up any attempt to apply their theory to practical purposes; but fortunately for us this did not in any way damp their enthusiasm for the subject itself, which they pursued, one must suppose, for the sheer love of the game, or perhaps with the idea of providing problems for university examinations. But whatever the impulse behind their work, Providence has, as usual, seen to it that their efforts were not wasted, for they laid the foundations of the science which has enabled us to seek for and obtain the very great reductions of resistance which are essential for high speed transport. For it so happens that when bodies are given the now familiar streamline shapes, the flow around them takes almost exactly the form imagined by the mathematicians for their ideal fluid, and the pressures exerted by the fluid on the surface of the body are so nearly the same as those given by the theory, that their net effect in resisting motion is, as the theory suggests, practically zero. Fig. 3 shows the theoretical flow and pressure distribution of the ideal fluid about a good streamline body; the real flow and pressure distribution for this body would be almost indistinguishable from these theoretical values.

Why then does a perfect streamline shape experience any resistance at all to motion? It is because the air, unlike the ideally slippery fluid, cannot actually slip over the body, but must exert a very slight dragging force along its surface, and it is this dragging force, or *skin friction* as it is called, which alone offers any appreciable resistance to the passage through the air of the best streamline shapes. Here then is a curious situation, for while everyday experience makes it seem 'natural' for us to suppose that the air should strongly resist the rapid passage of bodies through it, the difficulty, when the matter is approached

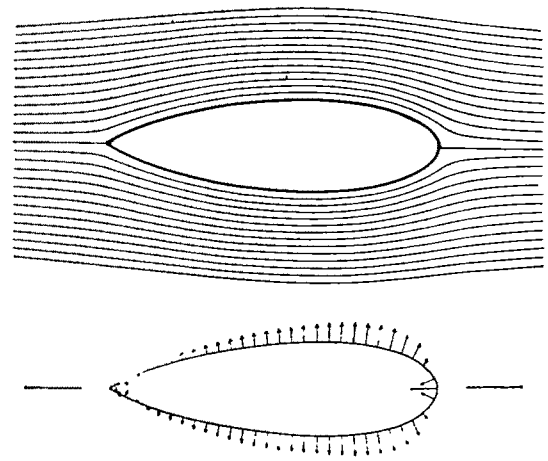

FIG 3.

from the theoretical end, is to explain why the resistance of any body is greater than the exceedingly small force which can be applied by the mere rubbing of the air over its surface. The wide gulf between the two points of view is shown by the fact that at the speed of modern aerial transport, the resistance of a badly shaped body may be as much as fifty times greater than that of a good streamline body of the same frontal area.

Now we have to find an explanation for the high resistances of unstreamlined bodies. This is due to a curious feature in the behaviour of the air flow, which would be impossible in the ideally slippery fluid; for the real air streams have the power of leaving a curved surface and forming pockets of what is called *dead air* behind the bodies. Within these pockets the pressure is low and so the bodies are, as it were, sucked backwards. On closing up behind these pockets the air stream becomes very turbulent and full of regular or irregular eddies which continually carry away the energy corresponding to that expended in moving the body against the high resistance.

(*To be continued*)

Nuclear Physics

THE British Association discussion at Norwich on nuclear physics on September 5 was opened by Lord Rutherford. After a review of progress resulting from the application of high voltages to nuclear transmutation, he passed on to discuss the rapid development of our knowledge of artificial radioactivity and in particular the production of such radioactivity by neutron bombardment. Neutrons, being uncharged, penetrate the heaviest nuclei without difficulty, and radioactive isotopes of the great majority of the elements have already been discovered. The effectiveness of neutrons in producing some types of transmutation is increased largely by slowing them down by passage through paraffin, water or other substances containing hydrogen, the neutrons losing energy by collision with the protons. By slowing them down in this way to thermal velocities, their adsorption by boron is increased 350 times, by cadmium 3,000 times, and by gadolinium 30,000 times, the effective cross-section for capture then being of the order of 10^{-20} sq cm. A demonstration that neutrons actually obtain thermal velocities is afforded by slowing them down in paraffin wax cooled to liquid air or liquid hydrogen temperatures. This extra cooling reduces the velocity still further, and an increase in the efficiency of disintegration has been observed by P. B. Moon and others.

Lord Rutherford considers that it would be of interest to see whether neutrons reach the upper layers of the atmosphere in appreciable numbers, and whether they can account for any of the cosmic ray phenomena. He hopes that future expeditions to the stratosphere will include apparatus for the detection of neutrons.

He passed next to discuss the new radioactive isotopes. These isotopes must exist in the sun or other hot stars where a natural nuclear bombardment must be constantly proceeding. They would therefore exist in the substance of the earth when it was first flung off from the sun, but in the course of time they would progressively disappear, only those with the longest lives such as radium with its unstable products remaining.

Dr. C. D. Ellis stressed the importance of the accurate measurement of the energies of electrons, γ-rays and protons emitted in related transmutations. Thus aluminium bombarded by α-particles can change into Si^{30} and a proton, or to Si^{30}, a neutron and a positron. An accurate measurement of the kinetic energies in the two alternative modes of transmutation would show whether in all cases the energy liberated in the positron emission is given by the maximum positron energy. It appears that many of the measurements made hitherto were quite unreliable, estimates of maximum positron energies varying by factors so large as two. Dr. Ellis expressed the hope that the exciting work of discovering new radioactive elements would shortly give way to more precise work.

A similar point was raised by Dr. J. D. Cockcroft. It is well known that carbon bombarded by deuterons can either give C^{13} with the emission of a proton or through the production of radionitrogen to C^{13}, a positron and a neutron. The kinetic energy release in the proton reaction has been measured carefully, and is 2·7 million volts. The total kinetic energy available for neutron and positron should thus be only 1·3 million volts. The maximum energy of the positrons on the other hand is at least 1·4 million volts, whilst the neutrons must possess some kinetic energy. A way out of the difficulty might be found by the discovery of other modes of energy liberation in the proton reaction although strong theoretical arguments have been advanced against the possibility of such other modes.

Dr. Cockcroft referred also to the properties of the new radioactive isotopes produced by proton and deuteron bombardment. Radioactive isotopes of lithium and boron have been discovered emitting electrons up to 11 million volts energies. Radiosodium which emits penetrating γ-rays can be produced by voltages so low as 500 kilovolts, but a 10-hour bombardment of a rock salt crystal with 10 microamps will produce a source emitting only 2,000 electrons per second, whereas an increase of voltage to 1·7 million increases the yield by a factor of 10,000. Prof. Lawrence hopes by advances in technique to increase the yield by a further factor of 1,000, and so to produce in a day a source of the same order of activity as a gram of radium. Prof. Lawrence considers that such sources might have great importance in biological work.

Dr. M. L. Oliphant showed how the accurate measurement of the kinetic energy changes in nuclear transmutations has led to a revision of the scale of nuclear masses. Until recently, the mass spectrograph data have been accepted without question, but several serious discrepancies have forced a reconsideration of the position. The mass of Be^9 has caused the greatest difficulty, for on Aston's and Bainbridge's figures it should be able to disintegrate spontaneously into 2 α-particles and a neutron. It appeared that all

the difficulties were removed by the assumption that a small error had been made in determining the mass of helium relative to oxygen. Since most of the masses were measured in terms of helium, a complete revision of the mass scale necessarily followed. Dr. Aston has since repeated his mass spectrograph measurements using the more accurate brackets now possible with the use of deuterium, and has confirmed that revision was necessary.

Mr. M. Goldhaber reported the experiment of Dr. J. Chadwick and himself on the γ-ray disintegration of the deuteron. The neutrons resulting from the transmutation have been detected by their action in disintegrating lithium ; the proton energies have been estimated at 240 kilovolts using radium γ-rays.

Dr. N. Feather reported a more accurate determination of this energy by the use of a Wilson chamber filled with 'heavy methane'. 40 proton tracks were measured, the proton energy being about 180 kilovolts. The distribution of tracks was similar to that expected for a photo-electric effect. The new work requires a proton mass of 1·0086 on the revised scale.

Dr. P. B. Moon demonstrated the production of induced radioactivity by neutrons, and in particular showed how enormously the effect with rhodium is increased by slowing down the neutrons by paraffin wax.

News and Views

Demonstration of Firewalking

A DEMONSTRATION of firewalking was given by an Indian, Kuda Bux, before members of the University of London Council for Psychical Research and other men of science at Carshalton, on September 17. The fire was contained in two trenches about 12 ft. long, 6 ft. wide and 8 in. deep. Barefooted, Kuda Bux walked along the trenches twice, and his feet made contact with the burning embers for some five seconds each time. Prof. C. A. Pannett of St. Mary's Hospital sends us the following account of his observations : "Kuda Bux is physically of the typical, slightly built, Indian type. The soles of his feet present no unusual features. The skin is not callous but soft, as the skin of so many individuals who walk barefoot. The feet felt cold to the hand, and a skin thermometer registered 93·2° F. This was about twenty minutes before the attempt, during which time the performer walked about the lawn. A five-eighths inch square of zinc oxide plaster was attached to the sole of the right foot. The skin of the feet was very dry. The feet were washed and dried carefully about fifteen minutes before the walk. After the steps had been taken, with a delay of perhaps ten seconds, the temperature of the soles of the feet was again taken. It was now 93° F. There was no sign of burning of the skin.

"AT the conclusion of the performance, after Kuda Bux had walked twice over the pit, an interval of perhaps forty minutes having elapsed, the feet were again examined. By careful scrutiny could be seen here and there the whitened appearance of the skin which occurs when the very surface of the epithelium is scorched without blistering. Yet with the pigmentation present it was very difficult to be positive of this. There were no signs of hyperæmia or blistering. The patch of plaster was quite unharmed, except that the fluff of the cotton basis at the cut edge looked very slightly scorched. If this were so, these cotton fibres must have reached a temperature approaching 120° C. Mr. Digby Moynagh, who had made an attempt to carry out a firewalk ten days previously, made a second one. The soles of his feet had a number of blisters on them, which were in the healing stage. After two steps he acquired new blisters. The soles of his feet were noticeably moister than those of the Indian, and this factor may be of importance, because at one place the dampness had caused a piece of the charcoal to adhere. Underneath it a burn occurred. Mr. Maurice Sheepen also made two steps on the glowing charcoal. Hyperæmic patches occurred on his soles, which doubtless were the beginning of blisters."

Our Indian Contemporary—*Current Science*

To those who are interested in following from afar the remarkable increase in the appreciation of scientific education and research in India, which has recently become so apparent, our contemporary *Current Science* has been indispensable. This journal, which now enters upon its fourth year, is ably edited by Prof. C. R. Narayan Rao, of Bangalore, with the active co-operation of all the leading men of science in India. It has been their aim to provide India with a periodical similar in its aims to NATURE and in this they have undoubtedly been successful. In the July issue, the future of Indian university education is discussed at length, more especially as it affects the pass degree graduates who are so numerous in India. The problem of finding employment for these is not solely an Indian problem, but there it attains a magnitude not met with elsewhere. It is suggested that the courses of study require modification to meet this difficulty, but we doubt if this would provide more than a partial solution of the problem. We think that much might be done by the introduction of Civil Service examinations for the lower grades of civil servants, which would remove from the colleges many unsuitable students. The question is one well worthy of study by an independent committee.

THIS issue of *Current Science* contains also a number of valuable scientific articles. Of especial interest is that by S. Rangaswami and M. Sreenivasaya on the disease of sandal. The discovery, that this disease is insect borne, has resulted from research work in which the biochemists of the Indian Institute of Science, Bangalore, and the entomologists of the Forest Research Institute, Dehra Dun, have been prominent. This investigation provides an excellent example of the value of well-organised team work, and it should result in the control and the gradual elimination of this disease from the Madras and Mysore forests. We congratulate the editor and his collaborators on the high measure of success achieved by *Current Science* and we note with pleasure that in future the journal is to appear fortnightly instead of monthly.

Hittite Art

A REPRESENTATION of a bull in silver from recent excavations in Anatolia, and described as the most important work of art of Hittite origin yet discovered, is to be exhibited at the forthcoming Antique Dealers Fair to be held at Grosvenor House, London, W.1. The figure is seven inches high, and is mounted on bronze and inlaid with gold. It is dated tentatively at the third millennium B.C. As an evidence of high artistic culture, it is without parallel among Hittite antiquities. An obvious comparison with Sumerian bulls from Ur is suggested. To this, reference is made by Prof. Ernst Herzfeld, whose authority on Hittite objects is unquestionable. In an interview with a representative of *The Times*, which appears in the issue of September 16, he discusses the affinities of the Hittite bull with other finds from Anatolia and elsewhere, mentioning in particular the figurines from mounds in south Russia and the Caucasus, of which the best known are in the Hermitage Museum, and a terra-cotta bull (*Bos primigenius*) from Nihawand in his own collection, which belongs to the Early Bronze Age of the third millennium B.C. Prof. Herzfeld also directs attention to the principle, important in discussion of the qualities and characteristics of art in the ancient East, and of a relevance here, which will be immediately apparent to archæologists, that down to Achæmenid times verisimilitude in line is frequently sacrificed to an artistic convention in attitude, which assimilates one species to another. This is apparent in this example in the manner in which the legs of a bull are represented in an attitude essentially capriform. It is thus evident that even at the early date to which this bull is assigned, an art, Hittite in all essentials, already conformed to a generalised eastern convention.

Fen Drainage Problems

IN view of the contiguity of the fen district to the locality of the Norwich meeting of the British Association, the presentation at the meeting of a paper on problems in fen drainage was appropriate. Major R. G. Clark, the writer of the paper, pointed out that there is an estimated total of 1,279,000 acres of fenland and lowland in England and Wales protected by artificial works from inundation by the sea or flooding from the rivers conducting the surplus water to the sea, and that the Bedford Level, which extends into the counties of Cambridgeshire, Norfolk, Huntingdonshire, Isle of Ely and other counties, comprises about 836,000 acres of fenland. The Bedford Level is traversed by the Rivers Nene and Ouse which serve to subdivide it into the North, Middle and South Levels.

ARTIFICIAL works in this district date back to about 1631, when Cornelius Vermuyden, the celebrated Dutch engineer, was commissioned to convert the Level area into 'summer lands', which he did by constructing various barrier banks, new cuts, etc. He appears, however, to have allowed insufficiently for the shrinkage of the newly-protected land, mainly composed of peat, in illustration of which, a photograph was shown of a column at Whittlesea Mere, the top of which marks the original level of the ground when drained in 1851 and now stands 11 ft. above it. The paper described the means adopted to produce evacuation of the water, and instanced the modern pumping installation at St. Germans consisting of three oil-driven units of the Premier-Crossley horizontal *vis-à-vis* type, each of 1,000 b.h.p., coupled through reduction gears to a horizontal centrifugal pump constructed by Messrs. Gwynne's Pumps, Ltd., the capacity of each pump varying from 1,000 to 300 tons per minute according to tidal conditions. Mentioning that the Middle Level Board has spent more than half a million sterling on new works and maintenance during the past twelve years, Major Clark concluded with the affirmation that, in future, State assistance will become necessary, urging that it will be a national disaster if these large food-producing areas of fen and lowland are not maintained and protected.

Meare Lake Village, 1935

AN exceptionally interesting find in the excavations of the Somersetshire Archæological and Natural History Society at Meare Lake Village of the present season, which ended on September 19, is that of a timber substructure of a remarkable and unusual character in one of the mounds. It consists of a squared arrangement of oak beams, 11½ feet in length, crossed at the angles and secured by oak piles or corner posts placed vertically through the mortice holes. The arrangement was almost square, the area enclosed by the timbers being fifty-three square feet. The inner area was crossed by one large oak beam; and poles of alder and silver birch laid out in parallel order in both directions under the oak beams combined to form a raft-like structure. The earlier rectangular building on this structure would appear, judging from the position of piles around the area, to have been superseded by the more usual round dwelling, of which the superimposed hearths were found in the position and relation in which they were to be expected. A somewhat similar square timber structure was found in the west village some years ago, and traces of rectangular huts were found

at five points, though not *in situ*, in the Glastonbury Lake Village. From the range of finds in the area of excavation of the present season, it is evident that this quarter of the village was a centre for weaving. Weaving combs, bobbings, needles of bone and no less than twenty-four spindle whorls were found. Among other objects were an iron dagger with bronze fittings, bronze finger rings, yellow paste beads, three spurs of fighting cocks, linked bronze wire and two 'cheek-pieces' of horses' bridle bits. Among the finds from the excavations of this and previous seasons, to be exhibited in the new Wyndham Galleries of the Somerset County Museum at Taunton, is a mounted set of the spikelets and grains of *Triticum dicoccum* found at Meare, with a set of its modern counterpart by its side. These have been prepared by Sir Rowland Biffen.

Spanish Influence on Progress of Medicine

On the occasion of the International Congress of the History of Medicine, to be held at Madrid on September 23–29, the Wellcome Research Institution has issued a booklet illustrating Spain's contribution to medical science from the earliest times down to the discovery of cinchona in the seventeenth century. After alluding to Spanish contacts with former civilisations such as those of the Phœnicians, Carthaginians, Greeks, Romans and Visigoths, the work deals with the Hispano-Moresque Renaissance, which was remarkable for the foundation of schools of medicine and pharmacy and the establishment of hospitals, some of which were equipped with large libraries, as well as for the appearance of eminent medical men, including Albucasis, the author of a great medico-chirurgical treatise which remained the leading textbook until the time of William of Saliceto (1275), Avenzoar, the greatest of the Hispano-Moresque physicians, and Maimonides, the Hispano-Jewish philosopher and physician, the octocentenary of whose birth has recently been celebrated. During the sixteenth and seventeenth centuries a large number of hospitals were founded in different parts of Spain, especially at Barcelona, Granada, Malaga and Madrid. The outstanding medical personalities of the sixteenth century in Spain were Nicolás Monardes, of Seville, whose private museum of natural objects was one of the earliest, if not the first, in Spain; Francisco Hernandez, physician to Philip II and author of a monumental work on the natural history of Mexico; and Andres Laguna, physician to Charles V and Pope Julian III and professor at the University of Alcalá de Henares, where Cardinal Ximenes the founder had endowed six professorships of medicine and two of anatomy and surgery. The booklet is illustrated by facsimiles of pages from Spanish medical works, portraits of Spanish doctors and views of the old hospitals.

Snake Bite in the United States of America

In 1908, Prentiss Willson gathered reports of 740 bites by poisonous snakes covering a period of almost a century. That result gave an entirely false idea of the prevalence of snake-bite in the United States, for Dr. T. S. Githens now records 2,376 cases which have come to his notice during the past eight years, and estimates that there may be 1,500–2,000 cases each year (*Scientific Monthly*, August 1935, p. 163). It may be, also, that the number of snakes is increasing, for when wilderness is converted into farm land, small rodents increase greatly in number, and these form the mainstay of the snakes' diet. The danger to health varies most with the amount of venom injected, and this is closely related to the size of the snake involved, so that the most dangerous species are the large Florida and Texan diamond-backs. The only local measure having any real value is the application of a moderately tight tourniquet, associated with free incision of the site of the bite and the swollen area and persistent use of suction. But the mainstay of treatment is the use of adequate doses of antivenum, a specific serum effective against the bites of North American vipers, which has reduced the mortality rate from 14·3 to 3·7 per cent. Of the 72 persons who died in spite of serum treatment, 25 were near death when the serum was first given, and in 6 other cases death was due to gangrene resulting from too tight tourniquets; more than half were children less than fourteen years of age.

The Voyage of Peter Mundy

In the *Proceedings of the Linnean Society of London*, Session 1934–35, Part 2, Mr. N. B. Kinnear and Mr. F. C. Fraser direct attention to the remarkable journals and zoological notes from the voyage of Peter Mundy, 1855–56. Some very clever sketches are reproduced showing a remarkable vivacity, and his notes show that he was a careful observer. Three volumes of his travels have already been published by the Hakluyt Society; the fourth and final volume is being edited by Miss Anstey, who assisted the late Sir Richard Temple with the earlier volumes. The running bird from Ascension Island illustrated which "can neither fly nor swimme" is identified as a rail, now extinct, and the strange seal-like creature from St. Helena is thought to be a sea elephant, which, although never recorded from so far north, is a very strong swimmer, and it is apparently just possible that one could have reached this island. The third picture represents a whale, identified by Mr. Fraser as an adult Atlantic right whale. Mundy's description of the feeding mechanism is stated to be quite correct, and he is probably one of the first to have given a true account of this.

Zoological Gardens of Travancore

It is not easy to realise what great efforts are being made in all parts of the Empire for the interest and instruction of the people in matters of natural history. The Zoological Section of the Public Gardens at Trivandrum contained last year ("the year 1109 M.E.") 149 mammals, 225 birds, 26 reptiles and 20 fishes; and the growing popularity of the institution was indicated by an increase in the number of visitors to 462,566 from the 302,425 of the preceding year.

Extensive improvements were carried out, including the building of a new aviary, the extension of the carnivora house, and an open arena for lions and tigers. And "all the members of the menial staff of the three Sections were provided with suitable uniforms, for the first time, with suggestive badges for the respective groups; and the whole staff looks exceedingly smart when thus arrayed on ceremonial and festive occasions. . . . The year 1109 was one of the most progressive in the annals of the institution, and has marked an important land mark in the various stages of its development for years." (Administration Report to the Government of His Highness the Maha Raja of Travancore, 1109 M.E.)

Marine Biology in Ceylon

THE administrative report for 1934 of the marine biologist of Ceylon, Mr. A. H. Malpas, shows that as the results of restricted inspections by dredging of the pearl banks there were no spatfalls in the northern paars and Cheval paars. A certain number of second and third year oysters were, however, present, but not in sufficient quantities to offer a prospect of immediate fisheries, although if conditions are favourable they may provide heavy spatfalls. A scheme has been prepared for the establishment in Colombo of a fisheries research station combined with an aquarium which is under consideration. This provides in the first instance for a small biological research station capable of being enlarged as funds are available. It will be equipped with research laboratories and fresh-water and marine aquaria essential for fisheries investigation work. An aquarium will be attached, to which the public will be admitted. This is an alternative scheme to one outlined in earlier reports which provided for exhaustive investigations in these waters with a modern fishing vessel equipped with the latest fishing appliances in order to determine the lines on which the local industries could be most profitably developed, which the Executive Committee for Local Administration has definitely decided to abandon. Under the new scheme, the field of research will include investigations into life-histories and general bionomics of all aquatic animals of importance in Ceylon, into the culture of pearl and edible oysters, into the farming of estuaries and fresh-water fishes and turtle, and into the importance of various indigenous larvivorous fishes in relation to the suppression of tropical fevers and the breeding and distributing of the most active forms throughout Ceylon.

Baltic Countries

THE Baltic Institute, which was founded at Torun in Poland in 1926 for the investigation of Polish and Pomeranian economic problems, has widened its scope in the publication of a journal entitled *Baltic Countries*, which is to appear three times a year at the annual cost of five dollars. The August number contains more than a dozen articles, all in English, on various aspects—geographical, economic and historical—of Sweden, Finland, Denmark, Estonia and other Baltic lands. Russia and Germany are excluded from the scope of the review. The editorial committee of twelve is drawn from the universities of Baltic and Scandinavian countries, England and the United States. A supplement to the issue contains the first instalment of the proposed Baltic Year Book which gives the usual statistical tables. This is to be completed in four issues, and then published separately. *Baltic Countries* promises to be a useful addition to geographical and economic journals.

Religious Broadcasting at the Eucharistic Congress

THE broadcasting of the services at the International Eucharistic Congress of World Catholicism at Buenos Aires in October 1934 to the largest and most widely diffused religious congregation in history was made possible by the radio telephone. On the closing day, October 14, the Pope, Pius XI, speaking into a microphone on his desk at the Vatican, gave the concluding message not only to a million worshippers kneeling in the streets of the Argentine capital, but also, by means of retransmissions from Buenos Aires to broadcasting stations on three continents, to a very considerable proportion of the clergy and laity throughout the world. In *Electrical Communication* of July, two papers describe the broadcasting arrangements and the radio telephone system which rendered possible this world-wide service. No longer are the delegates to these international congresses crowded together in a cathedral with straining ears. Walls or park boundaries or national frontiers or even oceans now offer no restrictions. Without wireless, the management of the large crowds drawn from a metropolitan area having nearly three million inhabitants would have presented almost insuperable difficulties. Chile, Peru and Colombia were linked up by transcontinental land lines and Uruguay by a subfluvial cable. The able and willing co-operation of the Government telephone departments of many of the leading countries in the world ensured the success of the international broadcasts.

Industrial Power in Great Britain

AT the National Electrical Convention held at Bournemouth on June 3–8, a paper on industrial power supply was read by F. Forrest, H. Hobson and C. Taite. They examine very thoroughly the dependence of Great Britain upon her manufacturing industries and how much mechanical and electrical power they take. Although widely extended use is being made by industry of the public electric supply services, a still wider use is advocated, as it has a cumulative effect upon economy of production, and many of the existing mechanical power plants are not economical. The introduction of labour-saving devices has proceeded more slowly in Great Britain than elsewhere; mass production methods also are much more widely applied in the United States and Germany. Compared with her principal competitors, there is a relative deficiency in the total power equipment per wage earner of Britain. This deficiency is partly due to the nature of British industries, which demand a greater proportion of hand processes, and

in part to their earlier and more gradual development. The percentage of workers engaged in manufacture is appreciably higher in Britain than in the United States, France or Germany. The total horse-power has advanced from 1½ horse-power per wage earner in 1907 to 2·81 per operative in 1930. Taking the average price of coal and electric power to be 100 in 1922, their prices fell to 75 and 59 in 1932. The advent of the Grid has enabled great reductions in capital cost owing to the use of much larger dynamos. In 1934, the average size of *machine* ordered was 40,000 kilowatts, which is four times the average size of a generating *station* in 1926. Examples are given showing how the Grid is leading to the decentralisation of industry.

Progress of Welding

THE new Institute of Welding founded this year amalgamates the two organisations formerly known as the Institution of Welding Engineers and the British Advisory Welding Council. An abstract of the address of the new president, Sir Alexander Gibb, to the Institute appears in the *British Engineers' Export Journal* for July. It is pointed out that, on the Continent, there are many buildings more than twelve stories high constructed by welding. In Great Britain the entertainment hall at Bexhill is the first large building in which welding was used. Several all-welded ships have been constructed, and have proved very successful in everyday use. In most ships, including destroyers and cruisers, bulkheads and strength decks are welded. Welded underframes will be used for the Silver Jubilee train which will run from London to Newcastle (268 miles) in less than four hours—necessitating long stretches at more than 100 miles an hour. In the United States, the Burlington Zephyr diesel high-speed train, built of welded stainless steel, attains a speed of 100 miles an hour in its daily service between Kansas City and Lincoln, doing the 251 miles in four hours. In the electrical industry, practically all the largest machines are now fabricated by electric welding. In hydro-electric development, welded high-pressure pipe lines are the standard practice. Many bridges have been constructed in this way. In Belgium two dozen truss bridges are being built over the Albert Canal, some of the spans being 250 feet long. In Germany more than two hundred railway bridges have been built with spans up to 170 feet, and road bridges with spans of 300 feet.

Norman Lockyer Observatory

THE second edition of the Handbook of the Norman Lockyer Observatory (Sidmouth: Norman Lockyer Observatory. 6*d*.), compiled by Dr. W. J. S. Lockyer, director of the Observatory, is dedicated to the late Miss Winifred Lockyer who until her death in July 1934 voluntarily acted as assistant secretary and librarian. The handbook refers warmly to her willing and cheerful service, and to her many generous gifts. The beginnings of the Observatory date from 1912, shortly after the retirement of Sir Norman Lockyer from the Solar Physics Observatory at South Kensington, and the transference of that Observatory to Cambridge. To promote its development, the Observatory in 1916 was formed into a Corporation. The Observatory was originally known as 'The Hill Observatory', but in 1921 the Council of the Corporation changed its name to that which it now bears as a fitting reminder of its founder's eminence in astrophysics. The principal instruments are the 12-in. McClean telescope, the 10-in. Kensington telescope and the Mond photographic equatorial. The first two are devoted to astrophysical problems —the study of *B*-type stars which exhibit emission lines in their spectra, and the determination of spectroscopic parallaxes (of which more than 2,000 have been measured up to date) form the main investigations. The third instrument, presented to the Observatory by Sir Robert Mond four years ago, consists of a battery of four short-focus telescopes designed for photographing large regions of the sky. Of the history of the Observatory and its programme of work, the Handbook gives an interesting account, and it is well illustrated with photographs.

Mining Electrical Engineering

AT the annual conference of the Association of Mining Electrical Engineers held in Nottingham last July, suggestive comments were made on the directions in which engineering progress could be most helpful in mining. During recent years, notable advances have been made in developing safety lamps, flameproof switchgear of all kinds and signalling. In the latter department, experiments between the surface of the ground and the workings underneath have been made with a fair amount of success by means of wireless, but sub-surface radio still remains a possibility of the future. In his presidential address, Mr. A. W. Williams, whilst admitting the progress that has been made, urged that they must never be content with the present degree of efficiency. Engineers at the present time pay special attention to standardisation. Practically every commodity used in connexion with electrical apparatus is either standardised or is being studied with that end in view. He fears that this tendency will retard efforts to further research in the directions of safety and efficiency, and tends to put a check on individual initiative and investigation. Mr. Williams does not approve of some of the devices introduced to control apparatus at a distance, for they cannot always be trusted to work satisfactorily; they make for safety in some ways, but increase the risks in others. From the mining engineer's point of view, they offer few, if any, compensating advantages by increasing the efficiency of coal production.

Destructive Earthquakes in 1934

IN the last two numbers of the *Matériaux pour l'Étude des Calamités* (79–84, 152–155; 1935), M. Charles Bois has given a list of 54 destructive earthquakes that occurred during the year 1934. The only great earthquake of the series was that of northern Bihar on January 15. Three others, one in China and two in Mexico, may have reached the highest

of Prof. Milne's three degrees of intensity. The most remarkable feature of the year was, however, the occurrence of only one semi-destructive shock in each of such well-known seismic regions as Italy, Greece, Japan, the Philippines, California and New Zealand. The total number of lives lost was unusually small, in Bihar about 2,000, and in all the rest, according to M. Bois, the total is only 39.

Animal Welfare

THE third "Animal Year Book", published by the University of London Animal Welfare Society (price 2*s*. 6*d*.), contains a variety of articles of interest to naturalists. Most important of these are A. H. B. Kirkman's account of whales and whaling; a summing up of the state of affairs in regard to oil pollution of coastal waters by J. McMath and L. Parker; and a symposium in which correspondents in different lands abroad give summaries of their own country's legislative and other efforts for the protection of animals. The hon. editor is Dr. C. M. Knight.

Science in Hong-Kong and South China

THE first number of a new volume (4) of the *Hong-kong Naturalist* (May 1935) carries on the tradition of its predecessors in offering articles dealing with many different aspects of scientific knowledge. An excellent account of stone rings and their manufacture, and the first of a series of articles on the legends and stories of the New Territories are of archæological interest; and the curious Chinese habit of eating melon-seeds is described and discussed historically. The pipe-fishes and their relatives continue the synopsis of Chinese fishes, and the series on the birds and the orchids of Hong-Kong are continued.

Key to British Trees and Shrubs

A USEFUL key to British trees and shrubs has recently been compiled by C. T. Prime and R. J. Deacock (Cambridge: W. Heffer and Sons, Ltd., 1*s*.). The key is divided into two sections, the first giving the summer diagnostic features (chiefly the leaves), and the latter the winter features. The key is arranged in a simple flora style, and should not give rise to any difficulty. There are 57 diagrams. Unfortunately these are in very rough outline, and in many cases will not help in identification; this applies especially to the diagrams of winter twigs. More detail is not only desirable, but also essential, if these illustrations are to carry out their intended function. The price is high for a pamphlet of 39 pages.

Canadian Minerals

A USEFUL publication is "The Canadian Mineral Industry in 1934" published by the Department of Mines, Ottawa. It gives in alphabetical order, for a score of metals and some thirty minerals, details of occurrence, production and trade as regards Canada. Details are given also of important developments and prospective sources of further supply within the Dominion. The volume provides in a convenient form a complete survey of Canadian mineral resources and also authoritative figures.

Announcements

M. ALFRED LACROIX, perpetual secretary of the French Academy of Sciences and professor at the Museum of Natural History, Paris, has been nominated Grand Officer of the Legion of Honour.

THE tercentenary of the university of Budapest founded by Peter Pazmany in 1635 will be celebrated at Budapest on September 27–29, when the following, among others, will receive the title of doctor *honoris causa*: Sir Frederick Gowland Hopkins, Sir Charles Sherrington, Prof. Ludwig Aschoff, of Freiburg im Breisgau, Dr. G. Roussy, dean of the medical faculty in the University of Paris, and Prof. Anton von Eiselberg of Vienna.

THE following have recently been elected honorary members of the German Rontgen Society: Dr. Antoine Béclère of Paris, Prof. Rudolf Jaksch-Wartenhorst of Prague, Mr. A. Charles Thurston Holland of Liverpool, Dr. J. M. Woodburn Morison of London, and Dr. Pfahler of Philadelphia.

THE International Society of Medical Hydrology will hold its annual meeting in Brussels and Ostend on October 12–17, when the following subjects will be discussed: the action of carbon dioxide on the peripheral circulation, the therapeutic action of mud baths, and the therapeutic action of a sea climate. The first two subjects will be discussed in Brussels on October 13–14 and the third at Ostend. The intervening days will be spent on a visit to Mordorp and Spa. Further information can be obtained from the Secretary of the International Society of Medical Hydrology, 100 Kingsway, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in agricultural botany in the Edinburgh and East of Scotland College of Agriculture—The Secretary (Sept. 25).

An entomologist in the Horticultural Research Station of the University of Cambridge—The Secretary, School of Agriculture, Cambridge (Sept. 25).

A part-time demonstrator in zoology in the University of Manchester—The Registrar (Sept. 26).

Junior assistant in the Directorate of Ballistics Research—The Chief Superintendent, Research Department, Royal Arsenal, S.E.1 (Oct. 3).

A research assistant in the Mathematics Department of the Imperial College of Science and Technology—The Secretary (Oct. 4).

A curator of the Department of Archæology and History, and a curator of the Departments of Ethnology and Ceramics in the Art Galleries of Glasgow—The Subscriber, City Chambers, Glasgow (Oct. 15).

A lecturer in structural engineering and mechanics in the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 479.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Precursors of Coprosterol and the Bile Acids in the Animal Organism

THE transformation of cholesterol into coprosterol in its passage through the body involves a reduction of the $C_5 : C_6$ double bond, and a transition from the *allo*cholanic- to the cholanic-ring system. Although it is established that the bacterial flora of the intestine is concerned in the reduction process, the mechanism by which the stereochemical change is brought about is unknown. A clue was afforded by a study of the properties of cholestene-3 : 4-diol, a primary oxidation product which is formed under various conditions of mild oxidation from cholesterol, and is also a constituent of the resinous product called 'oxycholesterol'[1]. Being an α-glycol, this substance easily rearranges by loss of water into the corresponding ketone, that is, cholestenone. Since cholestenone (= coprostenone) yields coprostanone on reduction, which in turn is reducible to coprosterol (= coprostanol) and *epi*-coprosterol[2,3], we formed the working hypothesis that the reactive primary oxidation product, cholestene-diol, may play a role in cholesterol metabolism, giving rise to the formation of cholestenone as an intermediary product. On this assumption, cholestenone and coprostanone, and not cholesterol itself, are the immediate precursors of coprosterol which is formed from them in the intestine by bacterial reduction. Further, an explanation is afforded for the origin of the *epi*-hydroxycholane system in lithocholic acid (and the other bile acids ?)[4], which may be derived from *epi*-coprosterol by oxidative cleavage of the side chain with loss of acetone.

On subjecting this hypothesis to experimental test by means of feeding experiments on animals, we found that the addition of cholestenone to various diets poor in cholesterol gave rise to a large increase in the excretion of faecal coprosterol. This increase did not, however, account for the whole of the ingested cholestenone, and since only a small amount was excreted unchanged, it is possible that the remainder may have been converted into bile acids. This question, as well as the action of intestinal bacteria on cholestenone, is being further investigated.

It may be pointed out that a similar mechanism may underlie the metabolic processes leading from cholesterol to certain sexual hormones (progesterone, androsterone) which contain either a keto group or an epimerised hydroxyl at C_3.

O. ROSENHEIM.
T. A. WEBSTER.

National Institute for Medical Research,
N.W.3.
Sept. 5.

[1] Rosenheim and Starling, *Chem. and Ind.*, 52, 1056; 1933.
[2] Grasshof, *Z. physiol. Chem.*, 225, 197; 1934.
[3] Ruzicka, Bringger, Eichenberger and Meyer, *Helv. Chim. Acta*, 17, 1407; 1934.
[4] Ruzicka and Goldberg, *Helv. Chim Acta*, 18, 668; 1935.

Statistical Tests

IN a letter to NATURE of August 24, Prof. Karl Pearson states: "From my point of view, the tests are used to ascertain whether a reasonable *graduation* curve has been achieved, not to assert whether one or another hypothesis is true or false."

This assertion must come as a surprise to many who are familiar with Prof. Pearson's writings. It should not, however, be permitted to divert attention from the points raised in Mr. Buchanan-Wollaston's letter of August 3, for whatever may have been Prof. Pearson's original intention in introducing the term 'goodness of fit', and in publishing a table of the distribution of χ^2 (the theoretical form of which had been previously determined by Helmert in 1875), it is certain that the interest of statistical tests for scientific workers depends entirely from their use in rejecting hypotheses which are thereby judged to be incompatible with the observations.

It is certain, too, from many passages which could be cited from Prof. Pearson's own writings, that he has himself used the χ^2 test, not only in connexion with the graduation of frequency curves, but also as a means of testing the truth of theories or hypotheses. As one example, I may mention an appendix of five pages entitled "On the Test of Goodness of Fit of Observation to Theory in Mendelian Experiments" (*Biometrica*, 9, pp. 309–314). In this paper he insists very clearly, and quite in accordance with modern usage, taking the extreme case $P = 0$, that either the theory or the observations must be rejected.

Mr. Buchanan-Wollaston's point that the χ^2 test, like the other tests of significance, is cogent for the rejection of hypotheses, but, in the opposite case, by no means cogent for their acceptance, deserves to be widely appreciated. For the logical fallacy of believing that a hypothesis has been proved to be true, merely because it is not contradicted by the available facts, has no more right to insinuate itself in statistical than in other kinds of scientific reasoning. Yet it does so only too frequently. Indeed, the "error of accepting an hypothesis when it is false" has been specially named by some writers "errors of the second kind". It would, therefore, add greatly to the clarity with which the tests of significance are regarded if it were generally understood that tests of significance, when used accurately, are capable of rejecting or invalidating hypotheses, in so far as these are contradicted by the data; but that they are never capable of establishing them as certainly true. In fact that "errors of the second kind" are committed only by those who misunderstand the nature and application of tests of significance.

R. A. FISHER.

Galton Laboratory,
University College,
London, W.C.1.

South and East African Stone Age Typology

Two separate communications[1,2] this year on the archæology of South Africa bear indirectly on East African problems now being investigated in Uganda by this expedition.

In the first, Prof. Dreyer directs attention to the similarity that exists, in his opinion, between certain human skulls found in association with implements of Early Mossel Bay type, and those of Kanjera, Kenya. From the fact that these relics came from the base of a superficial black layer, he draws the conclusion that they are of post-Pleistocene age. Below the black layer is a red sand deposit which contains Late Stellenbosch implements (Acheulean cum Levalloisian) with which, in a shelter, Prof. Dreyer has also had the good fortune to find human remains. He makes the dubious assumption that if we regard the Middle Stellenbosch as being the culture of the same people "we at last come to the [man] more or less contemporaneous with Leakey's Kanjera man".

The uncertainty of the association of the Kanjera fragments[3] with the Chellean tools found in the same area precludes discussion of the relative ages of these two sets of human remains; but as Prof. Dreyer suggests that owing to the thickness of the beds at Kanjera, Leakey may have over-estimated their age, it should be noted that the East African Chellean forms part of a very long evolutionary sequence and that no late dating will satisfy the period of time required. Moreover, Middle Stellenbosch is not the same stage as the Chellean found at Kanjera, but several stages later. Actually, it is more akin to the East African Early Acheulean. In Uganda this stage marks the beginning of a large-core technique for the manufacture of *coups de poing* and cleavers, and many of the finished implements have inclined platforms very like the Clactonian, and simply due to the same sort of core technique for the detachment of flakes. Evidence is available in Uganda which suggests the presence here of a large flake culture, separate from, but contemporary with, the Chellean.

In the second communication, Prof. van Riet Lowe again directs attention to the use of a prepared core technique for the production of large flakes, afterwards trimmed into handaxes and cleavers of Upper Stellenbosch age, and deals, let us hope, the final blow to the Victoria West Mystery.

In Uganda, geological proof of the date of the Early Acheulean is more or less settled, and shows that the industry had begun when the Intrapluvial in Pluvial II (Wayland) started, and is the same as the stage near the top of the red Bed III, at Oldoway, which similarly marks the climatic break. This oscillation may be equated with that between the Kamasian and Gamblian pluvials—the evidence being based on the succession of types following the Early Acheulean in Kenya, at Oldoway and in Uganda.

Owing to the fact that the Upper Stellenbosch is followed by Lower Fauresmith (Late Acheulean cum Old Levalloisian), whereas in East Africa the Early Acheulean is followed by several stages which are, at first, free from Levalloisian influence, one is inclined to think that the presence of a core and flake technique in a *coup de poing milieu* of early date is not necessarily evidence of the appearance of proto-Levalloisian, but rather due to the tardy borrowing of a Clacton or other early flake technique, which was especially suited to the production of cleavers.

In East Africa, as in South Africa, the earliest appearance of the true Levalloisian (with tortoise cores and faceted striking platforms) as a contemporary of a *coup de poing* group was in Upper Acheulean times.

T. P. O'BRIEN.

African Prehistoric Research Expedition,
c/o Standard Bank of South Africa, Ltd.,
Kampala, Uganda.

[1] NATURE, 135, 620, April 20, 1935.
[2] NATURE, 136, 58, July 13, 1935.
[3] NATURE, 135, 371, March 9, 1935.

Emission of Positrons from a Thorium-Active Deposit

USING the magnetic focusing method, we have investigated the energy distribution of the positrons emitted by a source of thorium-active deposit. The positrons were registered by counting the coincidences they produce in two Geiger-Müller counters[1]. The source from which the positron emission was observed was an aluminium strip 10 μ thick activated with thorium B + C. The total number of positrons was about 0·02–0·03 per cent of the number of β-particles from thorium C + C″.

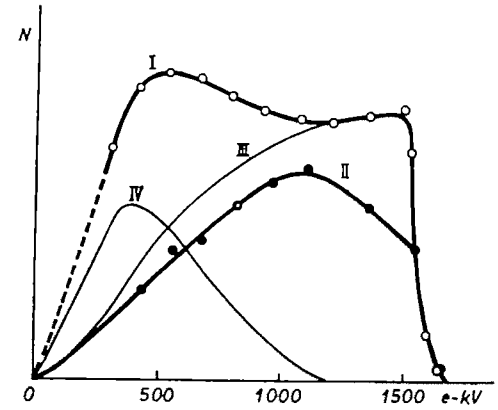

FIG. 1.

Chadwick, Blackett and Occhialini[2] inserted a weak preparation of thorium-active deposit in a cloud chamber, and observed a few (24) positron tracks issuing from the source. According to their data, the number of positrons was nearly 1 per cent of the number of β-particles, about 50 times the ratio we find in our experiments, but their statistical error was large. We have also compared the number of positrons emitted by the source with the number obtained by the process of materialisation of γ-rays from thorium C″. In this experiment the same source was surrounded by a lead shield 3 mm. thick; in this case the number of positrons measured was four to five times greater than with the source uncovered. In Fig. 1, curve I, the energy distribution curve of positrons emitted by the thorium-active deposit is given. For each point on this curve about 1,500 particles were counted, the statistical error being thus not greater than 3 per cent. The very abrupt fall of this curve near the end of the spectrum corresponding to the energy $h\nu - 2mc^2$ should be noticed. For comparison, we give a positron distribution curve, II, obtained by irradiating a lead strip 25 μ thick by the γ-rays from thorium C″. The asymmetry of this curve shows very clearly the effect of the nuclear field on the positive charge of the positron.

The very abrupt fall of the curve near the end of the spectrum ($h\nu - 2mc^2$) in the case of positrons from a thorium-active deposit is in good agreement with the theory of internal conversion of γ-rays on negative levels, worked out by Hulme and Jaeger[3]. In Fig. 1, curve III shows the theoretical curve for the conversion of the γ-line ($h\nu = 2{,}620$ ekv.) according to Hulme and Jaeger. The remaining portion (IV) of curve I, as we have already suggested in a similar connexion in the case of radium C, is probably to be ascribed to the effect of the β-radiation. If we separate in this way the effect of the γ-rays, we obtain for the probability of the internal conversion of the γ-rays of thorium C″ about $4{\cdot}5$–$5{\cdot}5 \times 10^{-4}$, close to the theoretical value of $4{\cdot}6 \times 10^{-4}$ given by Hulme and Jaeger. The remaining number of positrons, which we ascribe to the effect of β-radiation, amounts to about one positron per 1×10^4 disintegrating atoms of thorium C and C″. More accurate measurements with radium C showed that for the positron yield a value of 0·02–0·03 is to be accepted.

A. I. ALICHANOW.
A. I. ALICHANIAN.
M. S. KOSODAEW.

Physico-Technical Institute,
Leningrad.
June 16.

[1] A. I. Alichanow und M. S. Kosodaew, *Z. Phys.*, B, **90**, 249; 1934.
[2] J. Chadwick, P. M. S. Blackett and G. P. S. Occhialini, *Proc. Roy. Soc.*, A, **144**, 235; 1934.
[3] J. C. Jaeger and H. R. Hulme, *Proc. Roy Soc.*, A, **143**, 708; 1935.

Formation of Drops in Supersaturated Vapour of Heavy Water

AN investigation of drop-formation in D_2O vapour, which was supersaturated by means of adiabatic expansion in a modified Wilson apparatus[1], gave the following values of the critical degree of expansion ($E = v_2/v_1$) for D_2O/H_2O mixtures, with and without an electric field:

Mol per cent D_2O	T_{abs}	$E_{crit.}$ with electric field	E_{crit} without electric field
99	289·5	1·252 ± 0·003	1 230 ± 0 002
43	288 5	1·262 ± 0·003	1 240 ± 0 003
0	289·0	1·276	1 248

T_{abs} is the temperature of the vapour before expansion.

From the figures, the critical supersaturation of D_2O vapour at $T_{abs.} = 264$ was calculated to be 4·5, whereas the corresponding value of H_2O was 4·8. The result is quantitatively not in full agreement with Volmer's theory of formation of nuclei, which has been proved to hold good for a number of substances. According to Selwood and Frost[2] the surface tension of heavy water should be 5 dynes/cm. lower than that of normal water, and thus after Volmer the critical supersaturation of D_2O at $T_{abs.} = 264$ should be 4·2.

This slight discrepancy might be due to an error in the surface tension value of heavy water (too low), and this point is to be further investigated.

The large quantity of heavy water needed for the present investigation was provided by Norsk Hydro-Elektrisk Kvælstof A/S.

L. TRONSTAD.
H. FLOOD.

Technical University of Norway,
Trondhjem.

[1] M. Volmer und H. Flood, *Z. phys. Chem.*, A, **170**, 273, 1934.
[2] P. W. Selwood and A. A. Frost, *J. Amer. Chem Soc.*, **55**, 4335, 1933.

Isotopic Constitution of Gold from Band-Spectroscopic Examination

PROF. A. J. DEMPSTER has recently announced[1] his mass-spectrographic result on the suspected gold isotopes Au^{197} and Au^{199}, using his newly designed positive ion source, and his results point to the non-existence of Au^{199}.

For several years I have made many exposures of the AuH violet $^1\Sigma \rightarrow {}^1\Sigma$ band system in the hope of detecting Au^{199} by this method, using a 25-plate reflecting echelon, a quartz Lummer plate or a 40-plate transmission echelon. The resolving power should be adequate to separate the two isotope lines if the ratio of Au^{199} to Au^{197} existed approximately in the ratio of 1 : 8·3 (or 1 : 7·0, if the atomic weight is recalculated on the $O^{16} = 16$ scale), as expected from the accepted chemical atomic weight of gold, namely, 197·21, and also if the two AuH molecules behaved normally, that is, had no appreciable electronic isotope effect compared with the already very small vibrational plus rotational effect (usually smaller than 0·05 cm.$^{-1}$). On none of the plates, on which the main line is strongly over-exposed, has the satellite been recorded, in agreement with Dempster's result.

Details of this work with photographs will be published in the Institute's *Scientific Papers*.

SUNAO IMANISHI.

Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo.
Aug. 12.

[1] A. J. Dempster, NATURE, **136**, 65, July 13, 1935.

Mechanism of Three-Carbon Tautomerism

WITH the object of throwing light on the mechanism of three-carbon tautomerism, we have studied the equilibration of vinylacetic and crotonic acids in the presence of 1·05 mols of sodium hydroxide in dilute 'heavy water' at 100° C. As a check, we have also examined the behaviour of butyric acid under the same conditions. The isotopic ratio in both the recovered solvent and the water obtained by combustion of the residual sodium salts has been determined by a flotation method accurate to one part per million of density; the necessary purifications were carried out without loss of water, thus avoiding the possibility of isotopic fractionation.

The results are summarised in the following table, in gm. of D_2O, calculated from the experimental density values and theoretical yields of solvent and combustion water respectively.

Acid	Original solvent	Final solvent		Combustion water	
		Found	Calcd.	Found	Calcd
Butyric	0 6533	0 6542	0 6533	0 0001	0
Crotonic	0 8704	0·8658	0 8704	0 0002	0
Vinylacetic	0·8704	0·8613	0·8631	0 0068	0 0073

It is evident that whilst there was no detectable interchange with butyric and crotonic acids, substantial interchange occurred in the case of vinylacetic acid. The theoretical values in the latter case (corresponding to the interchange of one atom) have been calculated on the assumption that no isotopic discrimination occurs in the interchange reaction. This assumption is not necessarily valid (cf. A. Farkas, "Orthohydrogen, Parahydrogen and Heavy Hydrogen", Cambridge University Press, 1935, p. 200) and it is proposed, in extending the

(8) It is probably true that the fishes fly more freely in sunshine than in dull weather, but they do fly under an overcast sky as successfully as in sunshine. They are also known to fly at night, especially when they are disturbed by artificial light.

A good deal of unnecessary mystery seems to have been made about the flying fish's flight. The real mystery is the acquisition, by this one small group, of a fin and tail structure adapted to 'flight' and a singular adroitness in using it.

E. L. GILL.

South African Museum,
Cape Town.
July 27.

Structure of the Proboscis in Blood-sucking Diptera

WITH reference to Dr. B. Jobling's letter[1], I wish to point out that, as already mentioned[2], the hypothesis advanced by me concerning the feeding mechanism in blood-sucking diptera was of a tentative character, and that the object of my communication was not to generalise, but to report certain observations made by me on the feeding mechanism in one species of blood-sucking fly, namely, *Stomoxys calcitrans*. As a matter of fact, I have since carried out a large number of dissections upon specimens of several species of *Culicines* after feeding them on a strong solution of eosin sweetened with sugar, and while in a few instances no staining was found to have occurred in any part of the proboscis, in others it was the labrum-epipharynx that was found to have taken the stain along the whole of its length, indicating that the food-channel in insects of this class is probably formed by the apposition of the labrum-epipharynx and the hypopharynx.

As to the salivary duct in *S. calcitrans*, it terminates, as already mentioned, at the base of the hypopharynx, the lumen of the latter being a groove running centrally to near its tip.

S. K. SEN.

Imperial Institute of Veterinary Research,
Muktesar-Kumaun, U.P., India.
Aug. 20.

[1] NATURE, 136, 145, July 27, 1935.
[2] NATURE, 135, 915, June 1, 1935.

Points from Foregoing Letters

FEEDING experiments on animals, carried out by Rosenheim and T. A. Webster, have shown immediate precursor of faecal coprosterol esterol but cholestenone, arising presumably mary oxidation product, cholestene-diol. role of cholestenone in the conversion by the animal body of cholesterol into bile acids and certain sexual hormones is discussed.

The interest of statistical tests for scientific workers, Prof. R. A. Fisher writes, lies in their use in rejecting certain hypotheses incompatible with observations. He agrees with Mr. Buchanan-Wollaston that the logical fallacy of believing a hypothesis to be true merely because it is not contradicted by the available facts, does frequently occur.

The type and succession of prehistoric stone implements (Chellean, Acheulean) found in East Africa (Uganda) are compared by T. P. O'Brien with those from South Africa, recently described by Prof. Dreyer and by Prof. van Riet Lowe, and their bearing on the geological age of Dr. L. S. B. Leakey's Kanjera man is critically discussed.

The number and energy distribution of positive electrons emitted by thorium-active deposit agrees with the view that the electrons are produced by the materialisation of γ-rays of thorium C″, according to measurements by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew. The graphs show a residual effect ascribed by the authors to the production of positrons accompanying negative electrons (β-radiation).

The critical supersaturation at which drops of heavy water are formed (by adiabatic expansion) has been determined by Dr. L. Tronstad and H. Flood. They point out that if the value obtained is to agree with Volmer's theory of the formation of nuclei, the surface tension of heavy water must be greater than that reported by Selwood and Frost. (H. Lachs and J. Minkow have actually reported, in NATURE of August 3, p. 186, a higher surface tension for heavy water.)

Spectrographic investigations by Dr. Sunao Imanishi of the violet bands of gold hydride indicate the absence of a gold isotope of mass 199; his findings are in agreement with the negative result obtained by Dempster with the mass-spectrograph.

Drs. D. J. G. Ives and H. N. Rydon, from the results of equilibration experiments in dilute 'heavy water', deduce that purely intramolecular mechanisms for three-carbon tautomerism are not acceptable.

To account for a black-eyed offspring of the fresh-water shrimp *Gammarus chevreuxi* of two red-eyed parents, K. W. Yarnold assumed that some sperms from a previous black-eyed mate had remained behind and fertilised the new eggs. As such an occurrence would render doubtful all genetical work done with that species, Mrs. E. W. Sexton gives a full account of the mating habits of *Gammarus*, indicating that no such successive fertilisation can occur.

The location of various species of parasitic nematodes in the small intestine of the sheep has been investigated by J. H. Tetley. It is concluded that the site of infection is determined during the larval stage, and that the stimuli determining the position arise in the duodenum at the point of entrance of the bile and pancreatic juice.

Dr. R. O. Hall finds that straightening and steaming certain animal (guard) hairs with supernormal curvature at the tip results in further contraction. This evidence, he maintains, opposes the three alternatives put forward by H. J. Wood to the 'weathering' hypothesis suggested to account for the apical curvature of those hairs.

Observations on the flying fishes off the West African coast are reported by Dr. E. L. Gill. The fishes fly through the air by repeatedly dipping the lower blade of the tail in the water in order to propel themselves, using the fins as planes.

Research Items

Divine Kings in Southern Nigeria

AMONG the Umundri group of the Igbo of southern Nigeria, there are two divine kings who are the spiritual heads of the people, and occupy different towns in the Akwa District, Onitsha Province. Originally there was only one king, but dissensions arose and part of the town of Aguku seceded to found Oreri with its own divine king. The descendants of the royal family live at Aguku and claim descent from a sky-being, Eri, who was sent down by Chiuku, the sun-god. They call themselves Umundri and declare that they are not Igbo. The king is chosen from three, originally four, royal families and is usually a youngest son, whose choice must be accompanied by wonders and signs. The coronation ceremonies, which have been studied by Mr. M. W. D. Jeffreys, administrative officer (*Africa*, 8, 3), have the twofold object of transforming a man into a god and of recreating the world. One condition must obtain invariably. Both the candidate's parents must be dead. Also he must make three prophecies which must be fulfilled. The ceremony opens with ritual death, burial and resurrection. The candidate remains buried for several hours and his tree of life is cut down and the usual sacrifices made. When the body is exhumed at sunset a banana-stem takes its place. The candidate's body is whitewashed with clay and water that he may fulfil the prayer that he shall rise with a vivid and shining body. He discards his ordinary clothes and thereafter wears only white or blue Igala ones. Copper greaves are put on his legs, but he goes barefoot. Henceforth he is a god, and his person sacred. His first wife, or queen, is also whitened and wears white garments. Together they begin a circumambulation, which occupies several months. On his return to Aguku, the king may never leave the royal city again. At the close of a year, before he ascends the throne, a ritual combat takes place in which he overcomes first a young and then an old man.

Amber in Palæolithic Times

AMBER, which becomes abundant in neolithic times, is rare on palæolithic sites. The first specimen of palæolithic age was found at Arensan (Pyrenées) and some fragments appeared at Isturitz, where also the Comte R. de Saint-Périer found a bead, the first find of a definite form. Some fragments have also been recorded on central European sites. The Comte de Saint-Périer now reports (*L'Anthropologie*, 45, 3–4) the discovery in October 1934 of the first specimen of palæolithic sculpture in amber. It was found in the Isturitz cave in the middle of a stratum, of which the age had already been determined as lower Magdalenian. It was beneath another Magdalenian level, which itself was beneath a stalagmite sheet. There can be no question, therefore, of an intrusion. The character of the material was not at first recognised. It was thought to be ivory; and it was only some time after that it was suggested by the Abbé Breuil, when he saw the object in the laboratory, that it might be amber. This opinion was confirmed by tests applied in the laboratory of the Louvre. The sculpture represents the head of a horse, of which the anterior portion has suffered an ancient fracture. The head is massive in form, with a heavy mane; the neck, where it joins the head, is thick. The eyes, which are level with the surface of the head, are differently treated on either side. The musculature is well marked, especially on one side. The style is good and typically Magdalenian. The patination on one side is reddish-brown, and on the other yellowish-orange. Before this find, objects of art carved in amber were not known before the mesolithic, when animal figures appeared in Prussia and Scandinavia. Objects of neolithic age which have been found do not include animal figures.

An Ancient Aztec Herbal

THE Smithsonian Institution has published a pamphlet to make known the discovery of the Badianus Manuscript in the Vatican Library ("Concerning the Badianus Manuscript, an Aztec Herbal, 'Codex Barberini, Latin 241' (Vatican Library)", by Emily Walcott Emmart. Smithsonian Miscellaneous Collections, vol. 94, No. 2). This treatise—a herb[illegible] describing the various plants and other mat[illegible] used in Aztec medical prescriptions—was th[illegible] of two Aztecs who were educated at the C[illegible] Santa Cruz, founded by the Spaniards in 15[illegible] posed originally in Aztec, it was immedi[illegible] lated into Latin in 1552. The chief au[illegible] to have been a certain Martin de la Cruz, the other was Juannes Badianus, the translator. The first chapter deals with head ailments; the second describes the treatment of sore and bloodshot eyes, cataract, fever and insomnia; the third is devoted to ear infections. Two interesting plants are described as cures for pain, which can be identified as being members of the *Datura* family. Besides the plants, various animal products, stones, earths and carbon, salts, 'bezoar stones', and others, were used in various concoctions. Facsimiles are given of the first and last pages of the Badianus Manuscript, and of the plate of the two plants of the *Datura* family. It is proposed to publish a facsimile of the full manuscript with its 91 colour plates should funds become available.

Alligator-Lizards in South-West America

A SYSTEMATIC study of the natural history of *Gerrhonotus* in south-western America (H. S. Fitch, *Trans. Acad. St. Louis*, 29; 1935) describes the alligator-lizards as showing indications of learning and rapid habit-forming, ranking high among reptiles for intelligence. These wood inhabitants exist on a diet ranging from the larger insects to small mammals and birds' eggs; hibernation and viviparity vary with the climatic characteristics of the habitat. As a means of self-protection, they will encircle a tree-branch with their bodies, holding the tail firmly in their mouths, or discard their tails as a decoy to divert the attention of the snakes and hawks that prey upon them. The high percentage of regenerated tails suggests that this ruse is frequently successful. The alligator-lizards show practically no trace of social behaviour; mating occurs once annually at a definite season governed by locality and species.

Gill Formation in the Embryo of *Triturus*

IN the earlier stages of the embryo of *Triturus*, gill formation can be effected by transplantation of any portion of the body surface, excepting the medullary plate; for self-differentiation of the surface tissue in this way, mesoderm appears to be essential for the formation of the gills (M. Ichikawa, *Mem. Coll. Sci., Kyoto Imp. Univ.*, Ser. B, 9; 1933). Transplantation of all three germ layers invariably causes perfect gills to develop, while if the endoderm is excluded in such grafting, gills are sometimes produced and sometimes not. As the embryo develops, the gill-forming faculty becomes increasingly restricted to the forward portions of the body; when the tail-bud appears, only the branchial ectoderm is capable of producing perfect gills, which have in all cases a definite polarity. The power of gill-production is now located solely in the proper position—the differentiated branchial ectoderm.

Colour Changes in the Eye of a Grasshopper

IN 1916, Prof. Okazaki noticed that the eyes of a long-horned grasshopper (*Hexacentrus japonicus*) were jet black when he collected the insects one evening, but on the following day were golden yellow. Several other insects show a similar change, and Hajime Uchida has studied the changes in another long-horned grasshopper, *Homorocoryphus lineosus* (*Jap. Jour. Sci., Imp. Univ. Tokyo, Zoo.*, 3, 517; 1934). Surrounding the cone of each ommatidium are two [illegible] pigment cells which change their position [illegible] to the intensity of the light. They contain [illegible]ules. Accessory pigment cells occupy the interspaces between ommatidia, and contain yellowish reflecting pigment granules. When the eye is exposed to light, the principal pigment cells and the granules within them retreat proximally, so that the apparent colour is due to the accessory cells. In the dark-adapted eye the principal cells entirely encircle the cone, pushing aside the accessory cells. When light-adapted insects are transferred to a dark room, the distal migration of pigment granules takes place very rapidly during the first twenty minutes, and thereafter slows down, so that the full dark-adapted condition is attained only after fifty minutes. In the reverse process, the rate of retreat of the black pigment granules in the principal pigment cells is proportional to the intensity of the light.

High Temperature Variations in Fungi

DR. B. BARNES has shown that heating the spores of *Eurotium herbariorum* and *Botrytis cinerea* has induced relatively permanent variations in the morphology of these two species. He has now studied a third fungus, with similar results ("On Variation in *Thamnidium elegans*, Link, induced by the Action of High Temperatures", *Trans. Brit. Mycol. Soc.*, 19, Part 4, June 1935). Two separate variants were produced when spores were heated to 55° C. for two minutes, and another mutant appeared on heating to 70° C. for a similar period. Temperatures above 70° C. killed the spores. *Thamnidium elegans* is normally a fungus of stable character, and remains unaltered through several years of artificial culture. The variants produced by the lower temperature began to revert to the original form after three years of culture; but the other has remained permanent. Variations relate to the size of the spore-bearing head and prolificacy of spore production.

Secondary Spores of Polyporous Fungi

A SHORT paper by S. R. Bose in *Phytopathology* (25, No. 4, 426–429, April 1935) traces the cytology of secondary spore formation in *Ganoderma*. Peculiar bodies which are really hyphal projections appear in the hymenium, between the normal basidia. The projections are at first binucleate, but the two nuclei quickly fuse, then split into a number of dark-staining bodies, which migrate to the apex of the protrusion. This swells to form the secondary spore, and the dark bodies afterwards reunite to form the spore nucleus. The paper mentions other Polyporaceous fungi which produce secondary spores, and discusses the effect of weather upon their appearance.

Identification of Australian Woods

NOTEWORTHY contributions to this important, but difficult, problem are contained in two publications (Technical Papers Nos. 15 and 16; 1935) issued by the Council for Scientific and Industrial Research of Australia. The first, by W. E. Cohen, deals with the coloured species of *Eucalyptus*, and describes a series of simple chemical tests such as the determination of the alkalinity of the ash, extraction tests, colour- and turbidity-reactions between extracts of the wood in various solvents and ferric chloride, water, or potassium ferricyanide, and several specific chemical reactions of a similar nature. These tests have been combined to produce a systematic scheme of identification into which fall the 540 samples examined; these represent 37 species. The second paper, by H. E. Dadswell and A. M. Eckersley, is concerned with the remaining principal commercial Australian timbers, which are mainly pored woods (hardwoods). The scheme of identification evolved in this case is based principally on those macroscopic features which can be conveniently ascertained by means of a hand-lens, such as the nature of the pores, parenchyma, rays, gum ducts and ripple marks. These are supplemented in some cases by microscopical data, and in a few instances by chemical tests.

Geology of Northern Nevada

WE have received from the United States Geological Survey, Bulletin 847—A, The Contact Mining District (Elko County, Northern Nevada) by F. C. Schrader. The district appears to consist of carboniferous rocks, mainly carboniferous limestone, intruded by a mass of grano-diorite with intrusive dykes of alaskite, andesite and other igneous rocks, the Palæozoic rocks being in places locally covered by Tertiary rocks, partly volcanic and partly stratified deposits. The ore deposits appear to be mainly distributed round the border of the grano-diorite, but are also associated with alaskite dykes. A large number of mines have been worked in this district, originally apparently for gold, but more recently for copper, which appears to be the main product, though none of the workings is very deep. Of course, with the low price of copper in recent years, operations have fallen off considerably.

Rock Salt in Road Construction

SECONDARY roads serving as connexions and feeders to the main highways are of two types, the 'floating surface' type and the soil stabilised type. The former is made by adding loose gravel or similar material to the road bed, the latter contains gravel

kept in place by a material containing clay which acts as a binder. The floating surface type requires almost constant maintenance as the loose material is cast about by the traffic. Unfortunately, clay expands and contracts between fairly wide limits when alternately damped and dried by rain, wind and sunshine. Untreated clay shrinks as it dries, and permits embedded material to form a floating surface. In *Roads and Streets* (U.S.A.) of August, the results of experiments on the effect of salt on clay, by Prof. H. Ries of Cornell University, are described. He finds that clay treated with salt shrinks much less than untreated clay and that it holds moisture much better. The rate of the capillary action of the soil moisture is slightly increased and this leads to the compaction of the soil producing greater density. Actual road construction in America during the last three years has proved the effectiveness in practice of rock salt for road stabilisation. It is not necessary to add salt to more than the top three inches of the road. The quantity of salt recommended varies from 8 tons per mile for a road 14 ft. wide to 12 tons per mile for a road 20 ft. wide. The amount of water required to produce the best compaction is more than sufficient to dissolve all of the salt. In dry weather a properly moistened surface 'sets up' in less than a day and requires little attention.

Research on Motor Vehicles

THE Research and Standardisation Committee of the Institution of Automobile Engineers has recently issued its fourth annual report. Two reports have been issued of the researches on cylinder wear, special attention being paid to the influence of various constituents in the lubricants used on the wear by abrasion and corrosion. The engine was run on medicinal paraffin to which various fatty acids were added. Much useful information was obtained in this way. A report of experiments on the wear and friction of brake linings has been issued, and gives the results of experiments on twenty-two different materials. The rate of wear and the coefficient of friction was found over a temperature range of 100°–400° C. Many manufacturers are urging the importance of carrying out further experiments on 'brake squeak', as definite information concerning its origin is lacking. It is interesting to notice that the results of the tests are improving the durability and performance of the vehicles. The vehicle operators therefore get the main benefit from these researches.

Ignition of Firedamp by Compression

WE have received from the Safety in Mines Research Board, Paper No. 93; not only is this paper interesting in itself, but it derives further interest from the fact that it is one of the last pieces of work done by the late Prof. H. B. Dixon (Mines Department: Safety in Mines Research Board. Paper No. 93: The Ignition of Firedamp by Compression. By the late H. B. Dixon and J. Harwood. Pp. 23. London: H.M. Stationery Office. 6*d*. net). The paper describes a series of laboratory tests, carried out with an appliance designed for the purpose, of the ignition temperatures and ignition pressures of various combustible gases together with air, mixtures of methane and air being, of course, the most important for the purpose of the Safety in Mines Research Board. It was found that a wide range of mixtures between 2 and 75 per cent of methane could be ignited, but that mixtures containing between 7 and 7·5 per cent of methane had the lowest ignition temperatures when compressed, the pressure being about 20 atmospheres and the temperature being about 450° C., whilst mixtures of firedamp and air containing less than 5 per cent or more than 14 per cent of methane cannot be ignited in the ordinary way. It was further found that in order to ignite mixtures of methane and air, containing 7–10 per cent of methane with air at ordinary pressures, this mixture could easily be ignited when the hole in the end of the pressure piece of the apparatus was about 2·25 mm. in diameter; when larger holes than these were used, copper discs of varying thickness, through which a hole was blown by the operation itself, were found capable of igniting the methane-air mixtures. It is obvious that these experiments can, as indicated by a paper of Dr. Wheeler's, have certain results in practice, but the paper itself does not indicate the practical application of the results obtained experimentally.

Mandelic Acid in Urinary Infections

THE use of the so-called 'ketogenic' diet in the treatment of certain urinary infections is now well established. Mandelic acid has recently been shown to serve as a useful substitute. The acid has now been put on the market (NATURE, Sept. 7, p. 401). As supplied by the British Drug Houses, Ltd., London N.1, the daily dose recommended is 12 gm. The a is issued in the form of 3 gm. tablets, each contai also 1·6 gm. sodium bicarbonate, to neutrali acid, and flavoured. One tablet should b after each meal dissolved in two tablespoo fluid ounce) of water. As the acid exerts i static effect only in an acid urine, it is also necessary to give a drug which will keep the acidity of the urine at or below *p*H 5·3. For this purpose, ammonium chloride is recommended, and two 1 gm. capsules should be taken four times a day after the mandelic acid. The *p*H of the urine is conveniently tested with methyl red, a slightly pink colour indicating a *p*H of 5·3 or slightly less. The British Drug Houses, Ltd., issues a special outfit for the treatment, including mandelic acid tablets, ammonium chloride capsules and the indicator.

Photometry of Nebulæ

THE first of a series of studies of extra-galactic nebulæ by P. C. Keenan (*Astrophys. J.*, 82, 62) describes the method in use at the Yerkes Observatory for measuring the total magnitudes of nebulæ by comparisons of extra-focal images. This work forms part of a co-operative survey of nebulæ organised by the International Astronomical Union under the leadership of Dr. Hubble, of the Mount Wilson Observatory. The zone assigned to the Yerkes Observatory being from + 50° to the North Pole renders it possible to make direct comparisons with stars of the North Polar Sequence. Nebular images only slightly out of focus are used (the total blackening of the plate being measured), and the most serious source of error is the irregularity in the shapes of the images. Corrections are applied for differential atmospheric extinction and for size of image, the probable errors of the resulting magnitudes being about ± 0·06. During the progress of this work, a number of hitherto uncatalogued nebulæ were discovered. A list of thirty-two of these, with their positions and magnitudes, is given at the end of the paper.

Hearing and Aids to Hearing

DURING the discussion on "Hearing and Hearing Aids" held by Sections J (Psychology) and I (Physiology) of the British Association in Norwich on September 5, the major point considered was the effect of intense stimuli upon the performance of normal and deaf ears. The matter was approached from two points of view; of the increase of intelligibility of speech, when amplified, for partially deaf patients, and of the effect of listening to loud pure tones upon the acuity of pure tone hearing in both normal and partially deaf ears.

Dr. A. W. G. Ewing and Mr. T. S. Littler, of the Department of Education of the Deaf, University of Manchester, first described the apparatus which they are using for investigating the first of these points. This consists of a microphone and amplifier situated in a small sound-proofed room. The output of the amplifier passes via a decibel attenuator to the reproducing system. In this way, the intensity of the sound applied to the observer's ear by speaking into the microphone can be varied at will from a [illegible]ubnormal loudness to one of 110 decibels above the [illegible]mal threshold. The power-level reached at any [illegible]ent can be read from an output meter connected [illegible] outgoing power-line.

[illegible]wing then dealt with the effect of amplifying [illegible] these means upon its intelligibility for [illegible]af observers. He showed, for example, [illegible] eight such observers, for five the intelligibility could reach 100 per cent. Of these five, two required an intensity level of 110 decibels, and the remainder required 70–90 decibels. In a control experiment upon normal subjects, 100 per cent intelligibility could not be achieved with loudnesses greater than 70 decibels; the intelligibility tests employed were of normal speech one foot from the microphone, and of 20 consonant sounds specially chosen.

Whilst it is clear that the number of observers used is too small to permit of any generalisation with regard to the deaf population as a whole, it is none the less a remarkable fact that more than half of these cases were enabled to hear speech, under amplified conditions, almost perfectly. Dr. Ewing stressed the fact that these results were obtained under laboratory conditions—it is clearly unlikely that so favourable an effect would be found when using any of the easily portable aids to hearing at present available. It must also be stressed that in these experiments, background noise, so evident when using a normal hearing aid, where it arises from defects inherent in the apparatus itself as well as from the more important source of the extraneous noise present in any normal environment, has been reduced to a minimum. The installation of the microphone in a sound-proof room, to take but one example of special precautions, would clearly be quite out of the question with a portable deaf-aid.

In the discussion at the end of the meeting Major Tucker, of the R.A.F. Research Establishment, Biggin Hill, raised an interesting point with reference to this paper. When listening to speech at very high intensities, he pointed out, the intelligibility is often lowered by masking of high-frequency (consonant) sounds by low-frequency (vowel) sounds. He suggested the possibility of increasing the intelligibility of much amplified speech by the introduction of suitable high-pass filters into the system. He pointed out that at least an experiment on these lines might be worth trying. Mrs. Ewing disagreed about the desirability of doing this, on the grounds that it might lead to distortion of a partially deaf child's speech. Mr. Littler also disagreed, on the grounds, among others, that if low tones are led to one ear and high tones to the other, a peculiar sensation that the sound is spinning round the head was sometimes experienced.

In his paper, Mr. A. F. Rawdon-Smith discussed somewhat different aspects of deafness. He described an apparatus, installed in the Psychological Laboratory, University of Cambridge, with which it is possible to produce very pure tones of great and controllable intensity, and of frequencies throughout almost the whole of the auditory spectrum. The apparatus is used for investigating the phenomena of experimental deafness, and consists of a beat-tone oscillator, amplifiers and attenuators, together with subsidiary frequency checking and monitoring apparatus; sinusoidal voltages from this equipment are led to a moving-coil ear-piece, situated in a highly sound-proof room. With this equipment, the modification of the normal audiogram by listening to intense pure tones for periods up to five minutes has been investigated. If sufficiently intense, such tones lead to a very considerable, though temporary, loss of acuity. Mr. Rawdon-Smith demonstrated that this acuity loss is not confined to the single ear stimulated—on many occasions a loss of acuity almost as great has been found in the ear nominally unstimulated. This, together with the fact that the losses in both ears may sometimes be temporarily removed or lessened by subjecting the observer to an unexpected stimulus, such as momentarily switching off the lights in the sound-proof room, has led him to the conclusion that these losses, usually referred to as being due to auditory fatigue, are partly of cortical mediation. Undoubtedly, peripheral fatigue losses do occur also, as it is possible to show that, in the mammalian ear preparation, using Davis and Saul's method of recording the electrical activity of the auditory mid-brain, a peripheral sensitivity loss occurs; this has been found using the mid-brain action potential (not to be confused with the Wever and Bray (cochlear) effect) as an index of auditory function. The phenomenon of experimental deafness can be regarded, therefore, as of dual origin—in part peripheral, which may be termed auditory fatigue, and in greater part of cortical mediation, for which auditory inhibition is the preferred terminology.

At the end of his paper, Dr. Ewing produced interesting evidence that such partially deaf patients as he has tested are immune from either of these effects; in short, the production of temporarily increased deafness in the already deaf, by listening to loud pure tones or to much amplified speech, even for relatively long periods of time, is impossible.

It is regretted that exigencies of space do not permit of a more detailed discussion of the remaining two papers. If the author has devoted overmuch

space to those already considered, it is only because he is necessarily more familiar with that material.

Dr. P. M. T. Kerridge dealt with the history and causes of deafness in London children in schools for the deaf. It is interesting to note from her analysis that, in the severely deaf group, almost half had been deaf from birth. Miss E. L. S. Ross discussed and analysed the results of an experiment in which a short story was read to two small groups of partially or severely deaf children, first without and secondly with an electrical aid of commercial manufacture. The children's reproductions of this story were marked according as they had, for example, grasped or missed the point, or understood or misunderstood the name of the central character. She showed that only with some of the children was a partial improvement of understanding secured by these means.

A. F. RAWDON-SMITH.

Ability, Opportunity and Social Status

IN a paper entitled "Ability and Educational Opportunity in Relation to Parental Occupation", which appears in the *Sociological Review* (27, No. 3, July 1935), J. L. Gray and Pearl Moshinsky bring forward evidence to show that the children of the less prosperous social classes lack the opportunity for higher education available to the equally able children of the financially prosperous classes. The investigation on which the evidence is based was carried out on nearly 9,000 children, between the ages of 9 years and 12 years 6 months, drawn from primary, post-primary (including central), grant-aided secondary, private, and preparatory schools in the London area, during the year 1933–34. Individual ability was assessed by the Otis Advanced Group Intelligence Test (Form *A*), and each child was questioned individually regarding parental occupation.

The authors point out that every attempt at morphological classification in social orders presupposes a social philosophy and a knowledge of the causes of social differentiation. The classification finally adopted by them represents a compromise between several current systems. The basis of group differences is taken as the nature of the work performed, but is modified "where it seemed advisable" by combination with differences in average income and in social status: the six main groups thus obtained are relatively homogeneous. They are: (*A*) Employing and Directive Classes; (*B*) Professional Classes; (*C*) Minor Professional and Other Highly Skilled Occupations; (*D*) Clerical and Commercial Employees; (*E*) Manual Workers; and (*F*) Miscellaneous Workers and Unknown Occupations.

The significant differences in educational opportunity between these socio-economic categories, revealed by the final analysis, certainly confirm the authors' belief that the groups do constitute real socio-economic strata.

It is evident that this classification correlates to some extent both with parental intelligence and with nurtural and environmental factors in the life of the child. The acceptance of the genetic evidence that highly intelligent parents tend to produce highly intelligent children, or the acceptance of the doctrine that nurture is the dominant factor in intellectual development, leads to the expectation of a small positive correlation between the intelligence of the child population examined and the parental socio-economic status. The value found by the authors is $0{\cdot}25 \pm 0{\cdot}008$, a value which is, however, too small to be used diagnostically. This value compares favourably with the value 0·28 found by Duff and Thompson* in an investigation of the parallel problem in Northumberland ten years ago. As the authors state (but not only for the reasons quoted) it is unwarranted to assert, by reason of the existence of the positive correlation, that intelligence is causally related to parental socio-economic status.

Some of the results of the primary analysis deserve special reference:

(1) In all cases, the children of teachers of every kind exceed the mean of the social group of highest intelligence. This is, perhaps, not surprising in view of the construction of the test used to obtain differentiæ.

(2) The children of the 'larger business owne[illegible] and higher executives group' are significantly infe[illegible] in mean intelligence to those of the profess[illegible] classes. Nearly every other investigator has [illegible] at this conclusion.

(3) It is probable that children of man[illegible] engaged in the newer industries, where, f[illegible] considerable mechanical ability is demanded, are superior in mean intelligence to those of all manual workers.

(4) The children of unskilled workers form a remarkably homogeneous group.

In the ultimate analysis of their material, the authors make a comparative study of the distribution among the various social orders of the opportunity for higher education and of the corresponding distribution of high ability, that is, ability to benefit from higher education, the lower level being taken at 130 *I.Q.* on the Otis scale or 120 *I.B.* (Index of Brightness) on the authors' scale. As a source of children of high ability, the 'manual workers group' is the largest numerically, although it contains the smallest percentage of able children within the group. Thus, 58 per cent of the children of the 'professional classes group' possess ability, and 23 per cent of the children of 'manual workers group' are equally able; but in terms of the ratio of able children in the group to the total of all able children, these figures are 5 per cent and 50 per cent.

The discrepancies between ability and opportunity are shown by the following figures: 95 per cent of the able children of the 'professional classes group' have the opportunity for higher education; 48 per cent of the able children of the 'clerical and commercial employees group' have the same opportunity; only 25 per cent of the able children of the 'manual workers group' receive the same facilities. Opportunity for higher education is wasted most by the children of the 'larger business owners and higher executives' and of the 'professional classes groups'. There are 49 per cent of the former and 35 per cent of the latter, in each group, with opportunity but

* *Brit. J. Psychol.*, 14, Pt. 2, 1924.

without ability. In the case of children selected by competitive examination at the age of 11 plus, only 1·0 per cent have the opportunity for higher education without having the ability to benefit by it.

These figures reveal striking differences between the educational opportunities available for children of equal ability but of parents of different social status; and these differences are inherent in the present social system. That is to say, they belong to nurture and not to nature. It might be added, in comment, that the validity of these results depends on the extent to which the intelligence test measures the ability of the child to benefit from the higher education of the type provided in secondary schools. This is a matter which some educationists would be prepared to debate. W. F. FLOYD.

Tell el-Amarna, 1934-5

AN exhibition of finds from Tell el-Amarna, results of the Egypt Exploration Society's expedition during the season 1934–5, opened at the rooms of the Palestine Exploration Fund, 2, Hinde Street, London, W.1, on September 16, and will remain on view until October 12. Further progress has been made in the excavation of the Royal Palace. Its total length has not yet been ascertained, as exploration has not proceeded beyond the modern road, but it is expected that it will fall not far short of a kilometre.

Operations of the season concentrated on the great [illegible]ll at the south end of the building, the harem [illegible]rter, and the state approach, paved with plaster, [illegible] runs on the western side of the harem to the [illegible] Hall'. Advantage was also taken of an oppor[illegible] make a record in tracings and photographs [illegible] sculptured reliefs in the Royal Tomb, which lies in a valley about four miles away. This is the burial place of the young Princess Maketaten, one of the daughters of Akhenaten (1387–70 B.C.), religious reformer and builder of Tell el-Amarna. No complete record of these reliefs has been made before, and owing to the fitting of a new doorway, the opportunity will not recur. The drawings from the tracings have not yet been completed; but the series of photographs, which show the representations of intimate scenes of mourning, including a visit of the Royal Family to the temple, forms part of the exhibit of plans and photographs, which illustrate the progress of the excavations and the character and extent of the building.

Although the finds of the season included several of striking interest, the total number of exhibits is not large. This is due to the fact that a large amount of the expedition's time was absorbed by the deep digging necessitated in the area of the approach way to the 'Broad Hall'. Here a large building, called the 'Shining of the Aten', and part of the approach had been demolished early in the reign of Akhenaten. The whole area had then been filled in with sand to a depth of ten feet and levelled to form a parade ground.

In this filling were found many fragments of the sculpture of the original building, which could not be used elsewhere. Hence the sculptures have preserved all their freshness. Among the selection shown are some singularly striking examples of graphic representation, such as, in particular, spirited horses, soldiers and servants bowing, a fine royal head, and two heads with arrogant expression, here labelled 'priests'. The approach way itself has yielded thousands of fragments of the rows of huge granite and quartzite statues with which it was adorned. These were systematically broken up at the time of the destruction of the city after the death of Akhenaten and the overthrow of his reformed religion.

In the harem quarter, with its garden surrounded by a colonnade carved with festoons of birds, one of the most notable finds was the model of a fish in gold plate, which may have formed a part of the decoration of a formal pond, or have been a royal toy. It is shown only by a photograph, the original remaining in Cairo. One of the most interesting portions of the Palace as yet explored is the great hall at the south end of the building. Its vast roof was supported by a forest of brick piers, and it was decorated with faience tiles. Complete examples of these are now shown for the first time. They show naturalistic flower designs with white daisies in faience inlaid. It is hoped that it may be possible to complete the excavation of the Palace in the coming season. This, however, must depend entirely upon the extent to which further financial assistance towards the cost of excavation can be obtained from subscription by the public.

The Bihar Earthquake of 1934

SOON after the occurrence of this great earthquake on January 15, Dr. J. A. Dunn and three assistants were sent to the areas chiefly affected. A preliminary report on the earthquake by Messrs. J. B. Auden and A. M. N. Ghosh has recently been published (*Rec. India Geol. Surv.*, 68, 177–239; 1935). A brief report has also been written by Mr. N. Nasu (*Bull. Earthq. Res. Inst.*, 13, 417–432; 1935), who spent seven weeks during the following summer in the central district.

Owing to the occurrence of the earthquake at about 2.13 p.m., the loss of life was much less than might have been expected from the damage to property. Including Nepal, more than 10,000 lives were lost, mainly in the crowded towns of Monghyr, Muzaffarpur and the Nepal valley. The isoseismal of highest

intensity (10, Mercalli scale) covers three tracts. The largest is bounded by an ellipse about 80 miles long from east of Motihari to Madhubani and about 20 miles wide. Two much smaller areas lie near Katmandu and at Monghyr, the total area enclosed within the isoseismal being 1,300 sq. miles. Important destruction to property was confined within an area of 31,000 sq. miles. The shock was felt near Madras, at Dharwar and, according to pilgrims, at Lhasa. At about the same time, a shock was felt in the extreme south-west of India, but this was not directly connected with the Bihar earthquake. The total disturbed area was about 1,900,000 sq. miles.

Surface undulations were seen by a great number of observers. It is difficult at such a time to estimate the dimensions of these waves, but, according to one observer at Muzaffarpur, the distance from crest to crest was about 5 ft. and the height of the waves about 6 in. The maximum acceleration was determined at several places by means of West's formula, the highest figure given being 3,270 mm. per sec. per sec. at Monghyr. The corresponding amount for the Mino-Owari earthquake of 1891 was 4,300 mm. per sec. per sec. The amplitude of the movement was 12 in. at Muzaffarpur and 5·2 in. at Katmandu.

One of the most remarkable features of the earthquake is the wide area over which sand and water were ejected from fissures and vents. Indeed, it is doubtful if the area has been equalled in any other known earthquake, for it amounted to about 18,000 sq. miles within the isoseismal 8. As a rule, the rise of sand and water seems to have taken place after the main shock had subsided, sometimes by as much as several minutes. The greatest height reached by the spurts of water was 6–8 ft. In places, the surface was so completely riddled with sand-vents that small areas might be compared with boiling porridge. The closeness of the vents and the wide area covered by the sand suggest that its origin was at no great depth below the surface. According to Mr. Nasu, the deposit of sand was in most places thin, the depth exceeding one foot within an area of not more than 300 square miles.

The ejection of sand attained its maximum within and near what has been termed the *slump belt*. This is a band within the isoseismal 9, covering about 4,700 sq. miles in Bihar and also including portions of Nepal, in which houses were tilted rather than crumbled and the subsidence of the ground was marked. Two lines were re-levelled by the Survey of India, and it was found that the area of subsidence of one foot or more coincides approximately with the slump belt. It may be a zone in which the alluvium was shaken down by the earthquake to a slightly lower level.

The epicentral area enclosed within the main portion of the isoseismal 10 lies about 50 miles to the south of the main boundary fault. Whatever movement, if any, occurred along this thrust plane below the surface, no signs of displacement were detected at its outcrop. It seems probable, therefore, that the movements responsible for the earthquake originated some distance to the south of the boundary fault and along thrust planes that are now concealed by the Gangetic alluvium. The two detached portions of the isoseismal 10 about Katmandu and Monghyr may be due to displacements relieving subsidiary zones of strains in these two areas.

C. D.

Science News a Century Ago

J. D. Forbes on the Puy de Dôme

On September 22, 1835, J. D. Forbes wrote to his sister: "Clermont seems to me the most pleasantly situated of all the large towns of France which I have seen. It is perched upon an eminence rising from an extensive and fertile plain, which forms a sort of bay amongst the hills which surround it for two-thirds of the horizon. These hills are, for the most part, connected with a plateau or table-land of granite, from which the volcanoes rise; and of these, the Puy de Dôme, the highest and most noted, is conspicuous from Clermont, being about the distance of the nearest Pentlands from Edinburgh, and greatly resembling some of them in shape. . . . The Puy de Dôme was the first mountain up which a barometer was carried, at the suggestion of the famous Pascal, and I ascended it fully as much in reverence for his memory as on any other account. He was a most remarkable man; and as he was a native of this place, I hoped to have obtained some new particulars about him, but in this I have failed".

Cost of University Education

In a letter to *The Times* dated September 22, 1825, "Justus" said: "I am a great admirer of our old Universities and consequently I am anxious that misrepresentation which is abroad should no lo be unnoticed—I mean an impression relating t expenses of education there. The charges fo actually constitutes the education are £2 term or £7 10s. per annum at Cambridge. charge comprises all the fees, which at the London colleges amount to £21 at the least, to say nothing of the necessarily superior education which may be obtained at the former arising from greater competition, access to the libraries (in which advantage London is very deficient), and those incentives to study which a better situation and greater quiet naturally generate. The expense of board and lodging are very moderate indeed; and I do not hesitate to assert that any young man may secure every advantage which those noble institutions can bestow at an expense of, at the very utmost, £30 per term, or £90 a year".

Naval Architecture in Great Britain

In 1832 Captain (afterwards Rear-Admiral Sir) William Symonds (1782–1856) was appointed to succeed Sir Robert Seppings (1767–1840) as surveyor of the Navy. He held the post for sixteen years, but often was criticised for his actions. On September 23, 1835, *The Times* said: "We have much satisfaction in announcing to the nation that the present disgraceful state of English naval architecture is likely to become the subject of a formal, and we trust, serious and candid inquiry in the next session of Parliament. Mr. G. F. Young has placed upon the order-book of the House of Commons the following notice of motion:—'That a select committee be appointed to inquire into the system at present adopted in the construction of ships for His Majesty's navy; to report how far that system is calculated to insure for the public service the advantages of scientific and practical knowledge of naval architecture, and of improvements in naval construction; and to suggest the best means for submitting to the test of impartial examination and fair competition

the relative qualities of ships constructed on the plans of different naval architects'. Such an investigation is most imperiously demanded, and it will be as important as it will be beneficial to the nation, if properly conducted and carried on without reference to the interests of individuals in office, but on the contrary, with an entire disregard to everything but the attainment of the truth. . . ."

Death of Antide Janvier (1751–1835)

ON September 23, 1835, Antide Janvier, one of the cleverest horologists of the eighteenth century, died in the Hôtel-Dieu in Paris at the age of eighty-four years. He was born on July 1, 1751 at St. Claude (Jura). From an early age, he showed remarkable mechanical skill, and, when still a youth, made a model representing the motion of the moon which Berthoud referred to in his "Histoire de la mesure du temps". At twenty years of age he constructed a fine planetarium. After spending some years at Verdun, where he married, in 1784 he went to Paris where Lalande recommended him for the post of horologer to the king, and where he met with encouragement from the Academy of Sciences. He was deprived of his emoluments during the Revolution, but after the Terror, he was placed in charge of a school of horology, and was well known as a successful teacher. In 1802, he was awarded a gold medal for an astronomical model declared to be the cleverest made during the eighteenth century. Devoted more to his art than to the making of money, his last days were passed in poverty. He published several works including a "Manuel chronométrique", 1810, and his "Recueil des machines composées et exécutées par Ant. Janvier", 1827. After his death, a subscription was opened to raise a monument to his memory.

Societies and Academies

PARIS

Academy of Sciences, July 29 (*C.R.*, 201, 309–368). GABRIEL BERTRAND: Observations concerning the contributions by the atmosphere of sulphur to arable soils. Results of a series of determinations of sulphur as sulphate in rain water collected at Paris, 1931–1932, and of one year at Grignon, 1934–1935. The latter figure, although small, is sufficient to meet the requirements in sulphur of most cultivated plants. CHARLES NICOLLE and J. LAIGRET: Vaccination against yellow fever by the living amaril bacillus, dried and coated. The dried material was coated with either yolk of egg or olive oil before inoculation. Ninety-one persons were inoculated: there was no local reaction and no anaphylactic trouble. A single vaccination by this method replaces three inoculations by the current method. EMILE MATHIAS: Dauzère's theory on the conductivity of the air in regions exposed to lightning. E. J. GUMBEL: The greatest age, distribution and series. Statistical study of tables of survival. ALFRED LIÉNARD: The problem of the oblique derivative in the theory of potential. PAUL MONTEL: A formula of Weierstrass. PAUL BOURGEOIS and J. F. COX: The origin of comets. BASILE FESSENKOFF: A method of evaluation of the absorption in galactic nebulæ. FERNAND BALDET: The resolution of Nova Herculis, 1934. According to an observation made at the Lick Observatory on July 4, Nova Herculis is double, with two components with 0·2 in. apparent distance. This is confirmed by observations made at Meudon on July 23 and 24. FRANÇOIS CANAC: The study of intercrystalline corrosion by the method of luminous diffusion. D. G. DERVICHIAN: The interfacial tension between two liquids. ARCADIUS PIEKARA and MAURICE SCHÉRER: New experiments on the magnetic change of the dielectric constant of liquids. The large Bellevue electromagnet has been utilised in the study of the effect of the magnetic field on the dielectric constant as a function of the intensity of the magnetic field, the wave-length, and the angle between the electric and magnetic fields. E. FRIEDLANDER: The absence of natural β-radioactivity of beryllium. All commercial beryllium salts possess a marked radioactivity, but this is removed by careful purification, and it would appear that the pure products possess neither β- nor γ-radioactivity. MLLE. NIUTA KLEIN: The variation of the refractive index of non-annealed glass as a function of the time. The experimental results described appear to indicate that the variation of the refractive index with time is due to the transformation of the β variety into the α variety of the glass, a transformation prevented by rapid cooling. MLLE. MARIE LOUISE DELWAULLE: The system bismuth iodide–ammonium iodide–water. ANDRÉ DE PASSILLÉ: The existence of a series of ammonium orthophosphates and orthoarsenates. G. DEDEBANT, PH. SCHERESCHEWSKY and PH. WEHRLÉ: The theory of the general circulation of the atmosphere. The average field of temperature. MME. ODETTE THELLIER: Condensation nuclei and particles in suspension in the atmosphere. PAUL CHABANAUD: The vomer, the ethmoidian complex and the peripheral path of the olfactory nerves of the soleiform Teleosteans. TIFFENEAU and BROUN: The microdetermination of ethyl, propyl and isopropyl bromides in the tissues of animals anæsthetised by these substances. OLIVIER GAUDIN: The comparative toxicity of the pyrethrines towards different classes of animals. Pyrethrines are highly toxic to Crustacea; with other animals, the toxic action is variable. MAURICE ROSE and HENRI BERRIER: The appearance of substances functioning as plant auxins, in the course of the development of *Discoglossus pictus*. JACQUES BENOIT: New experiments relating to the stimulation by light of the testicular development in the duck. CLÉMENT COURTY: The magnetic micro-estimation of iron in the blood. MAURICE PIETTRE: The physico-chemical action of some electrolytes on the myxoproteid of the blood serum. SERGE METALNIKOV and L. Y. MENG: The utilisation of micro-organisms against mole-crickets (*Gryllotalpa vulgaris*).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 413–506, July 15). FRANZ BOAS: The tempo of growth of fraternities. Data from the Hebrew Orphan Asylum in New York show that the brothers and sisters of children classified as tall, medium or short at a given age fall also into these groups, indicating inheritance of tempo of growth. Jewish immigrants into the United States measured in 1910 and born between 1850 and 1890 do not show the increase of stature generally characteristic of European populations during the past century, but their children often living under poor conditions in New York, show progressive increase in stature, indicating that environment is also a factor in determining bodily

form. P. VAN DE KAMP and A. N. VYSSOTSKY: Analysis of 18,000 proper motions derived at the Leander McCormick Observatory. Some general results obtained from this survey of stars between magnitudes 7½ and 14 are that the solar apex differs by 15° from that derived with respect to the bright stars, due possibly to a higher percentage of high velocity stars among the apparently faint stars, that the secular parallaxes are somewhat larger in northern than southern galactic latitudes and that parallaxes of groups of fainter stars in the Milky Way are larger than previously supposed, indicating heavy obscuration near the plane of the Milky Way. FRED M. UBER and T. H. GOODSPEED: Micro-incineration studies. (1) Localisation of inorganic elements in plant cell-walls. A special electric furnace for micro-incineration is described. Sections of tissues are held in position by a gelatin smear hardened by formaldehyde vapour. Photomicrographs of sections before and after incineration are given. They show absence of ash in intercellular substance, and limitation of mineral elements to the 'middle lamella' of the cell-wall. H. C. SHERMAN and H. L. CAMPBELL: Relation of food to regularity of nutritional response. Rats reared on a diet better than 'adequate' show more rapid growth, more successful reproduction and extension of the adult life-cycle; these responses occur with less variability than the responses of rats on an 'adequate' diet. M. A. BIOT: Quadratic wave equation: flood waves in a channel with quadratic friction. A mathematical investigation of the type of flood wave caused by the bursting of a dam. An exact solution of the equation of propagation of waves with quadratic damping is found. High amplitude waves are more quickly damped, and the damping effect depends on the volume of the wave and the friction coefficient of the channel. TH. DOBZHANSKY: Maternal effect as a cause of the difference between the reciprocal crosses in *Drosophila pseudo-obscura*. GEORGE D. SNELL: The determination of sex in *Habrobracon*. In this parasitic wasp, as in other Hymenoptera, the males normally arise from unfertilised eggs (a haploid generation). After inbreeding, however, males may arise from fertilised eggs (diploid) and are commonly sterile. The hypothesis is advanced that there are a number of pairs of factors, probably on different chromosomes, which when heterozygous cause diploid zygotes to become females. ALAN L. MITCHELL: The inheritance and linkage relations of kinky coat, a new mutation in the Norway rat. This character is inherited as a simple Mendelian recessive, and since it is not linked with other known characters, its gene appears to lie in a seventh chromosome. CHESTER STOCK: Titanothere remains from the Sespe of California. The remains were found in the uppermost Eocene horizon at one particular locality alone. HASSLER WHITNEY: (1) Differentiable manifolds in Euclidean space. (2) Sphere-spaces. G. A. MILLER: (1) Groups which are the products of two permutable proper sub-groups. (2) Largest groups determined by the squares of their operators. SAUNDERS MACLANE: Abstract absolute values which give new irreducibility criteria. W. SEIDEL: On a metric property of Fuchsian groups. NORMAN E. STERNROD: On universal homology groups. OSWALD VEBLEN: A conformal wave equation. A differential equation in generalised four-dimensional conformal geometry, somewhat analogous to the Dirac equation for the electron in classical relativity. A. G. JACQUES: The kinetics of penetration. (10) Guanidine. Plotting the rate of entry of guanidine into cells of *Valonia* against external concentration of guanidine suggests that entrance is preceded by a reversible action between this base and an acidic constituent of the protoplasm. HENRY BORSOOK: The correlation between excess calories and excess urinary nitrogen in the specific dynamic action of protein in animals. Further data are quoted in support of the view that a steady state is attained between the increase in energy metabolism and urinary nitrogen within four hours after the ingestion of protein. DICKINSON W. RICHARDS, JR., ANDRÉ COURNAND and ISRAEL RAPPAPORT: Relation of the regulatory mechanism of respiration to clinical dyspnea. Dyspnea, or distress, referred to the act of breathing, whether due to physical exertion or pathological conditions, is due to disturbance in the mechanical functioning of the organ of breathing. It is associated exclusively with sensory impulses from chest and lungs; and separated from the physical chemistry of respiration. CHARLES A. KOFOID: On two remarkable ciliate Protozoa from the cæcum of the Indian elephant. Two new genera of relatively large ciliate Protozoa are described. Both have several spirally curved ciliary zones arranged in a secondary bilateral grouping instead of the single dorsal zone in other members of the family, and show other advanced characters. The evolution of structural complexity in the protozoan parasites of herbivorous animals seems to have proceeded parallel to that of their hosts.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*

Sunday, September 22

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Gem Stones".*

FARADAY SOCIETY, September 26–28.—General Discussion on: "Phenomena of Polymerisation and Condensation", to be held in the Zoology Theatre, University of Cambridge.

Official Publications Received

Great Britain and Ireland

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 16, 1934. Pp. 125. (London: Chemical Engineering Group.) 10*s*. 6*d*.

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1935–36. Pp. 403. (Manchester: College of Technology.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1638 (S. 194 a and b): Water Pressure on Hull of Boat Seaplane. By E. T. Jones and W. H. Davies. Pp. 46+31 plates. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Other Countries

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending 31st December 1934. Pp. 31. (Kirstenbosch: National Botanic Gardens.)

Colony and Protectorate of Kenya. Forest Department Annual Report, 1934. Pp. 36. (Nairobi Government Printer; London: Crown Agents for the Colonies.) 1*s*.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. The Orthoptera of Costa Rica. Part 1: Mantidae. By James A. G. Rehn. Pp. 167–272+plates 7–10. (Philadelphia: Academy of Natural Sciences.)

Memoirs of the Geological Survey of India. Vol. 66, Part 1: The Natural Gas Resources of Burma. By C. T. Barber. Pp. x+172+xviii+14 plates. (Calcutta: Geological Survey of India.) 6.8 rupees; 10*s*. 6*d*.

University College of Rhodesia

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON
Telephone Number:
WHITEHALL 8831

No. 3439 SATURDAY, SEPTEMBER 28, 1935 Vol. 136

International Control of Aviation

THE prominence which the question of air raids and air defence is receiving affords a timely reminder both of the extent to which aviation is rather an international than a national problem, and of the way in which this new power of flight has become rather a menace than an aid to civilisation. A memorandum*, and also one of the six projected handbooks dealing with air raid precautions, have recently been issued by the Air Raid Precautions Department of the Home Office†. In a general preface to the handbook it is explained that measures for safeguarding the civil population against the effects of air attack have become a necessary part of the defensive organisation of any country which is open to air attack, and that the need for them does not arise from any belief that war is imminent. The risk of attack from the air, however remote it may be, is a risk which cannot be ignored, and preparations to minimise the consequences of such attack cannot be improvised on the spur of the moment, but must be made, if they are to be effective, in time of peace.

The handbooks are designed to describe a scheme of precautions which it is hoped would prove effective in preventing avoidable injury and loss of life or widespread dislocation of national activities, and endeavour to give the best available information on methods of passive defence against air attack. The handbook before us is intended primarily for the use of those who in a war emergency would be engaged on first-aid services for the civil population, especially members of the St. John Ambulance Brigade, the St. Andrew's Ambulance Association and the British Red Cross Society. It contains a sufficient account of the chemical agents likely to be used and the methods by which they might be distributed to enable such persons to appreciate the dangers to which they would be exposed, as well as adequate information on general principles with regard to protection against gas. Steps to be taken for the protection of rooms, etc., against gas, the use of respirators and protective clothing and the treatment of various types of casualties are detailed, as well as measures for the decontamination of personnel and material.

Both the matter and the general principle underlying the publication of these handbooks have already received severe criticism. In the first place, it has been pointed out that the precautions described in the handbook are quite inadequate to confer any real protection. At a recent conference in London it was strongly maintained that it would be impossible adequately to protect a large civil population during a gas attack, or prevent them receiving injuries afterwards from, for example, mustard gas lingering in different places.

It is true that the handbook only professes to deal with avoidable injury, but any attempt in this way to minimise risk may easily create a feeling of false security and encourage the belief that the danger can be entirely avoided. This risk has probably been responsible for opposition from those who emphasise the impossibility of affording civilians the same protection as the services because of the enormous cost. A statement signed by Sir F. G. Hopkins and a number of

* Air Raid Precautions Memorandum No 1: Treatment of Casualties and Decontamination of Personnel (Issued by the Home Office, Air Raid Precautions Department) Pp. 15. (London: H.M. Stationery Office, 1935.) 4*d*. net.

† Air Raid Precautions Handbook No. 2: Anti-Gas Precautions and First Aid for Air Raid Casualties. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 110. (London: H.M. Stationery Office, 1935.) 6*d*. net.

other men of science, and issued by the National Peace Council, takes this view. Adequate defence must provide security against the simultaneous, and not merely the independent, use of high explosive bombs, incendiary bombs and gas attacks. It is necessary to insist that, however wise the proposed measures may be in themselves, the only adequate defence against air warfare is the abolition of war itself, and to point out the danger of allowing precautions or palliatives to divert attention from the main objective.

It is very generally accepted that abolition of national military and naval forces could not be achieved without the international control of civil aircraft, and the more reasonable it is for the British Government or any other Government to consider the means of protecting the civil population from air attack, the more imperative it is that the means of introducing international control should be explored. Equally desirable is the careful examination of the practicability of establishing an international air police force such as has received forceful advocacy of late.

The many questions which arise out of these proposals, such as the relation of an international force to the League of Nations, the technical difficulties to be overcome or the methods of preventing misuse of civil aviation, merit close and scientific study; it may well prove that along these lines will be found the only adequate safeguard and security for all nations. Scientific workers have a special responsibility for assisting in bringing to bear on all such questions an unprejudiced mind and the careful and impartial scrutiny of every factor involved which should be characteristic of the scientific mind.

Inevitably the study of the problem of the air from this point of view leads to the consideration of the whole problem of the future peaceful development of civil aviation. It would be difficult indeed to find a more signal example of the frustration of science than is afforded by aviation, and it is inconceivable that the development either of an international air police force or of international control of civil aircraft could be more inimical to development than the national jealousies and obstructions hitherto in vogue. The effect of these was strikingly demonstrated in the able report on the economics of air transport in Europe recently submitted by M. Henri Bouchée to the special sub-committee of the Air Transport Co-operation Committee of the League of Nations.

The substitution of a single International Air Board of Control under the League of Nations for the twenty-six different controls now exercised by the separate States of Europe alone would remove many hindrances to the development of civil aviation, including restrictions on design, flying lanes and prohibitions to engage in entrepôt trade, and would provide far greater stimulus than is possible under the present conditions of national sovereignty. The powerful plea advanced by M. Bouchée for collective action, calculated on a European scale to meet European needs and based on strictly economic lines, utilising subsidies in a manner enabling air transport to establish itself once and for all, and affording aviation the freedom which is natural to it but which as yet it has neither demanded nor received is, however, only one aspect of the question.

The technical problem in civil aviation is equally important, and here the whole development of civil aviation has been warped from the start through the influence of the War But for that factor, as Colonel Moore-Brabazon has pointed out, aviation might have developed along different lines, quietly and efficiently, and civil aviation might have played the important part it is meant to do in intercommunication, the military side lagging behind. As a result of wartime development, civil aviation has become no more than an off-shoot of the great military organisations in various countries, and only in Great Britain and the United States can it be said that aviation has been allowed to develop free from direct military influence.

The Diesel engine provides a conspicuous example of the ulterior effect of military influence on civil aviation. From the civil point of view, the Diesel engine has many advantages, notably in burning a fuel of high flash-point and the price of which in Great Britain is less than half that of petrol. This engine, however, is of little interest for military purposes because its performance is not so good as that of the petrol engine and it is also heavier. Since the major outlook for a new type of machine depends on its possibilities for military uses, there is little inducement for the manufacturer to develop the Diesel engine, although there is no type of transport for which the petrol engine is more fundamentally unsuitable than for the aeroplane with its load of inflammable fuel.

If civil aviation is to develop to the full and render its due service to mankind, it must be

freed completely from military influence, whether technical or economic. The root of the problem lies in the conflict between the conceptions of sovereignty of the air and freedom of the air. Only as the latter conception triumphs can humanity hope that aviation will progress as an instrument not of war but of peace. Scientific workers can never rest content with the mere precautionary methods outlined in the handbooks and policy of the Air Raid Precautions Department. They can indeed contribute something to see that the precautions, so far as they go, are technically sound and are fairly and not unfairly criticised. They fail in their duty, however, if they do not also continue to point out that the only adequate defence or security against air attack lies in the abolition of war itself and in liberating aviation from the bonds imposed on it by the narrow nationalism expressed in the Air Convention of 1919, and clothing it with the freedom of service in which were conducted those technical and scientific investigations which first gave it birth.

The Changing World of the Ice Age

The Changing World of the Ice Age
By Prof. Reginald Aldworth Daly. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xx+271+8 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1934.) 22*s*. 6*d*. net.

IN this book Prof. Daly has reprinted the Silliman Lectures for 1934 which he delivered at Yale University to "an audience with a varying knowledge of the facts and principles of geology". But to make the book of greater value to more serious students, the lectures have been somewhat expanded. The author had a threefold aim: (1) to picture the remarkable effects of the Pleistocene glaciations and deglaciations upon the sea-level all over the world; (2) to illustrate some of the no less extraordinary changes in the geography of the regions that were heavily glaciated during the Ice Age; (3) to discuss the behaviour of the solid earth when it was loaded with the ice-caps and then relieved of those loads by melting and evaporation.

The book is divided into seven sections. A very large amount of material has been used, and many of the facts and instances cited are not easily found elsewhere because of the difficulty of access to many of the publications and the difficulty of reading some of the less-familiar languages in which they are written. At the outset, it may be said that the author accepts a number of hypotheses which some observers are not prepared to adopt, but he never misleads his readers into the supposition that these views are of unanimous acceptance.

In the first section, past and present ice-caps, their measurement and weights are described. Then the sequence of glaciations is considered and the author, while accepting the four glaciations of Penck and others, in Europe and America, lays stress upon the long duration of the second interglacial phase and its separation of the first twin glaciation from the second twin glaciation. These two peaks of climatic change in the glaciated tracts corresponded with two major pluvial stages in regions now relatively desert, and also with two major periods of deposition of loess in different continents. These climatic rhythms affected simultaneously the whole surface of the earth. An estimate of the duration of the Ice Age is given as nearly one million years. These considerations lead up to the urgent question of what caused the Ice Age; the author is frankly in doubt and confesses that the subject is still in the state of speculation and remains to him a baffling mystery.

The second section of the book will probably be of greater interest to European readers than are the remaining sections, for it deals with the recession of the Fennoscandian ice sheets; and especially to students of prehistory, for post-palæolithic man has left determinable evidences of sequences of culture in relation to geological changes all round the Baltic shores.

Pleistocene changes in the geography of northern Europe are registered largely by the marks left by the waves of the ocean that kept shifting its level, both up and down, all over the earth. It is not, perhaps, generally realised to what an extent the robbery of water from the oceans during the maximum glaciation depressed the general level of the sea; the author shows that the amount was probably as much as 90 metres all over the earth; and even during the last glaciation, a sinking of some 75 metres was attained. But he warns his readers against supposing that in the warmest interglacial stage the sea-level was higher than it is at present by more than a few tens of metres; and further, that the

strand-lines on the lands cannot be in uniform relation to the surface of the existing ocean because of the earth's elastic and plastic response to the loading and the unloading with ice and water.

The recession of the North American ice is discussed in the third section, and comparison is made with the European phenomena. This chapter may be described as indispensable to students of the Ice Age, and moreover it summarises in some fifty pages the great volume of matter not easily accessible to the student, that has been published in monographs, reports and the like in recent years, while its clearness is increased by an adequate number of good maps and pictures.

The mechanism of the earth's deformation and recoil, especially as regards the effects of the crust's yield to the ice-loads, is dealt with in the fourth section. The author directs attention to the need of distinguishing between the immediate, elastic and the prolonged plastic response to load and release, and prefers the hypothesis of 'punching' to explain the plastic upwarping around ice caps to the 'wave' or 'viscous bulge' theory.

The remaining sections are devoted to the consideration of the high and the low sea-levels of the Pleistocene in areas removed from the glaciated tracts. Special emphasis is placed upon the want of uniformity in heights above sea-level of the abandoned sea-beaches; it is pointed out that there can be no simple criterion of the eustatic emergence "based upon the naïve idea that this process gives strandmarks at constant heights all over the world". But the more recent the eustatic emergence, the fewer are the dangers of mistaking the traces of the corresponding strand-lines on the rocks of continents and islands.

Finally, the effects are discussed of the changes of sea-level upon coral reefs in Pleistocene times, and the 'glacial control' theory of atoll and barrier reefs finds preference to the hypotheses of Darwin and Dana respectively.

The book is thoroughly illustrated with maps and views, and the author is to be congratulated not only on them but also for departing from the too usual practice of giving insufficient references in the text to the illustrations. It is a book of first-class importance and of equal interest, and is written in such concise and clear language that any well-educated boy could understand it.

H. D.

Everyday Life of Extinct Animals

Vorzeitliche Lebensspuren
Von Othenio Abel. Pp. xv+644. (Jena: Gustav Fischer, 1935.) 24 gold marks.

EXTINCT animals are known chiefly by their fossilised bones, teeth or shells, which afford many clues to their mode of life and reproduction. There are, however, several other kinds of fossils which add to our knowledge of extinct animals as living organisms. Footprints, remains of food, coprolites, traces of disease and accident, and even remains of dwellings, are all most instructive when they are satisfactorily interpreted. These are described by Prof. O. Abel as "Vorzeitliche Lebensspuren" in the handsome volume before us Here they are discussed critically, with many original observations, and they are illustrated by an unrivalled series of photographs besides drawings and diagrams.

In the first chapter, on reproduction, the most interesting section is that on the young often found within the skeleton of Ichthyosaurians. Prof. Abel concludes that although the majority must be unborn embryos, a few may perhaps have been swallowed as food. The marked discrepancy in size sometimes observed among the contained young seems to justify this conclusion.

The second chapter, which is by far the longest, discusses tracks and footprints and the modes of locomotion which they imply. The interpretation of these fossils is difficult, because so little is known of the tracks of most animals which live now. The conclusions to be drawn from the hand-shaped footprints of *Cheirotherium* from the Trias, which have already been studied by Soergel, and the classification of reptilian footprints by Nopcsa, however, are valuable, and Prof. Abel reviews them in detail. He is of opinion that no undoubted footprints of vertebrates have hitherto been found in Devonian rocks, and he thinks that the *Thinopus* of Marsh is probably a coprolite of a fish. He also points out that some of the Carboniferous footprints have been wrongly interpreted: he would explain the so-called claws of *Onychopus*, for example, as being the marks of runnels of water into the print. It is curious to note that some imprints of the fins of fishes in motion have been preserved in the Jurassic lithographic stone of Bavaria. The tracks of crustaceans and worms are familiar.

The chapter on food and feeding is remarkably exhaustive, beginning with an account of the stomach-contents of the Siberian mammoth and the North American mastodon, and ending with a discussion of the feeding tracks of certain worms. Referring to the remains of land plants found inside the fossil 'mummified' bodies of the aquatic dinosaur *Trachodon*, and sometimes described as the food of this reptile, Prof. Abel advises caution in identifying the stomach-contents within skeletons. *Trachodon* must have fed in the water, and the fragments of land plants were evidently introduced into the fossil with the rock sediment. He also agrees with those who assert that coprolites marked by a spiral valve have never been found in Stegocephalian Amphibia or in Ichthyosauria: he refers all such coprolites to fishes, in which they have often been found.

Among borings and other traces of dwelling places which are described, the most interesting perhaps is the fossil nest of a termite from an Upper Pliocene deposit near Vienna. Among fossil examples of commensal and symbiotic animals, the most curious is *Kerunia*, from the Upper Eocene of Egypt, which seems to be a hydractinian associated with a crustacean. Among indications of injury and disease, the irregular rugosities on the snout of many crocodile-like Triassic reptiles are remarkable. The prevalence of disease among the bears which inhabited the European caves during the Pleistocene period is also interesting.

A brief account of fossil records of death struggles is followed by a final chapter on insects and spiders in amber, which is contributed by Dr. Adolf Bachofen-Echt. Like the rest of the volume, it is illustrated by photographs which are as remarkable as they are beautiful.

From this brief summary it will be seen that Prof. Abel's volume is not only a valuable work of reference in an unusual subject, but is also a stimulating contribution to palæontological research. A. S. W.

Mathematics and Materialism

The Search for Truth

By Prof. Eric Temple Bell. Pp. x+279. (London: George Allen and Unwin, Ltd., 1935.) 7*s*. 6*d*. net.

PHILOSOPHY is a subject of study as earnest and important as any individual science. Prof. Bell apparently does not share this view, however, for in his book, which has the characteristics of a brilliant joke, he simply uses some aspects of the history of science as an occasion to poke fun at philosophy and to launch an attack on philosophers. Thus, he tells us that a considerable part of the efforts of the Greek thinkers "seems to have centred round the verb 'to be' ". And again, that "Aristotle and Plato were presently to prepare the ingenious noose with which the Middle Ages were later to hang themselves; and Euclid was to tie knots around the vital parts of geometry which were to paralyse its creative function for two-thousand years" (pp. 97–98). Or again, that "the theologians of the Middle Ages before the Twelfth Century had built their cathedral of learning and reason" on the first half of Aristotle's logical treatise (p. 143). For him, St. Anselm, Abelard and William of Occam were "incurably logic-mad"; and Duns Scotus deserves immortality on the only count that "his name has passed into the English language in the word *dunce*".

Prof. Bell may dislike speculations that cannot be tested at this moment by experiment; he may even be praised for exposing fourth dimension charlatans; but he certainly does no service to real scholarship by carrying to extremes the process of "debunking", which seems to become a source of inspiration in many quarters, across the Atlantic especially. In any event, he has no right to be misleading as when he endeavours to draw a parallel between the invention of non-Euclidian geometries and the exposition of many-valued logics given by Prof. Lukasiewicz—two branches of knowledge which have neither the same origin nor the same implications.

It would serve no useful purpose to initiate a general argument about a book full of pointless remarks and stripped of all references, until its author takes the trouble of recasting his pronouncements in the habitual forms of a tolerant and well-founded controversy. We should also like him to tell us more about truth, for though he concerns himself, lightly we believe, with the "Search of Truth", all we hear about this important idea is that, for Prof. Bell, an "Eternal Absolute Truth", which has no reference to experience, is of no importance whatever.

With this mere confession of faith, however, materialism will fare no better. Without sharing this particular creed, we can say, nevertheless, that a skilful use of the history of science and the sociological interpretation of mathematics could

have prepared a serious case for materialist science, in spite of the difficulties of experimenting with transfinite numbers, non-Archimedian geometries and many-valued logics. Prof. H. Levy has hinted at such an interpretation in a chapter of "The Universe of Science". A parallel method was also suggested in an article on "Numbers and Numerology" in NATURE of January 20, 1934, p. 80, in which the attempt was made to raise to a higher level the whole problem of the relations of thought and number. Until we are given such an interpretation, it is difficult to acknowledge, as we are invited to do by the publishers of this work, that "materialist science at last has its Jeans". T G.

Prof. Hans Molisch's Recollections

Erinnerungen und Welteindrücke eines Naturforschers

Von Hans Molisch. Pp. xii+232. (Wien und Leipzig: Emil Haim und Co., 1934.) 10.80 gold marks.

IN this autobiography, written at the instigation of his friends and pupils, Hans Molisch gives us his recollections of a busy and not uneventful life devoted to the pursuit of science. His researches, particularly those into the microchemistry of plants, are well known in Great Britain, but with his personality we are less familiar. His biographical recollections will therefore do something towards our enlightenment.

Born in 1856 at Brünn, now famous as the seat of Gregor Mendel's epoch-making experiments, Molisch learnt, as a boy, in his father's nursery gardens, the methods of cultivating plants, which stood him in good stead when he became a plant physiologist. His training for this career he acquired at the University of Vienna under Julius Wiesner, whose assistant he afterwards became. His first professorial appointment was at the Technical College in Graz, and later he was promoted to the botanical chair in the German University of that town. He has a good deal of interest to tell us of the staff and the students of this university and something too of the ill-feeling which existed between the Czechs and the German students.

In 1897, aided by funds from the Academy of Sciences in Vienna, Molisch undertook a journey round the world, working for some time at the botanical gardens at Buitenzorg. Of his travels, as well as his work, he gives us an interesting account.

On the retirement of Wiesner in 1909, Molisch was appointed professor of plant physiology in Vienna, where he remained until his own retirement in 1928. Here he continued his microchemical investigations, but found his activities somewhat cramped by the absence of experimental grounds. In 1914 he visited England and only just escaped being interned on his return through France. While still holding his professorial chair in Vienna, he was invited to become for two years the director of the New Botanical Department of the Tôhoku Imperial University at Sendai, and on this occasion made his second journey round the world. He tells us a good deal about his stay and his work in Japan, though of course less fully than in the book he published in 1926.

After his retirement from the professorship at Vienna, he was invited to lecture and work at the Bose Institute in Calcutta, and the account of his work there will be read with interest. Molisch's account of the conditions in India and its people is worth perusal.

The author concludes his book, which contains his portrait and a number of other illustrations, with some reflections on 'life', stating his opinion that living matter has never arisen from lifeless inorganic matter, and his belief that the origin of life is at the present moment and perhaps will always remain insoluble—a riddle of the universe.

The Biology of Flowers

By W. O. James and A. R. Clapham. Pp. viii+116+41 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 8*s*. 6*d*. net.

THIS unusual book should prove valuable in inspiring enthusiasm for what is so often made a very dull branch of botany to the average student. Each flower is carefully described in readable language, so that, once having worked through the book, the student can turn to his more compact Flora well armed and ready to follow floral taxonomy with interest. The diagrams are singularly attractive, but there seems no excuse for their being reproduced on such a large scale, since most of them are either floral diagrams or halves of flowers. Nearly all could have been reduced to a quarter of their present size, without detracting from their usefulness; thus reducing considerably the size and possibly the price of the book.

(1) Theoretical Physics
By Prof. Georg Joos. Translated from the first German edition by Dr. Ira M. Freeman. Pp. xxiii+748. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1934.) 25*s*. net.

(2) Lehrbuch der theoretischen Physik
Von Prof. Dr. Georg Joos. Zweite Auflage. Pp. xvi+676. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 24 gold marks.

(1) THE first edition of the book by Dr. Joos appeared in 1932 and was favourably noticed in NATURE, 131, 221; 1933. The English edition now before us shows every sign of having been prepared with great care, and is written in clear and straightforward language, which is unfortunately more than can be said for many translations from the German. Only minor alterations and corrections have, apparently, been made in preparing the English version. We can congratulate Dr. Freeman on his very satisfactory performance of a task which we are glad to see accomplished.

(2) The second German edition contains a new chapter on nuclear physics, which consists mainly of a non-mathematical description of the new work on artificial transmutation and the newly-discovered elementary particles. There is also a brief addition concerning the method of magnetic cooling which has been applied with such success by de Haas, Simon and others to obtain exceedingly low temperatures. Otherwise there is little change in this admirable textbook.

It is a little strange to an English reader that a German cannot bring out even a new edition of a work on theoretical physics to-day without a prefatory reference to the *neues Reich* and the *harter Daseinskampf des deutschen Volkes*, but we suppose that it has its reason. We further note the addition of a glossary explaining 'foreign' terms, in which *Absorption* (*Verschluchung*), *Elastizität* (*Dehnbarkeit*), *Kapillarität* (*Haarröhrchenkraft*) and such-like non-Prussian words, are translated into the new German, although these 'foreign' words appear in the articles in Gehler's "Physikalisches Worterbuch" of more than a hundred years ago. Merkwurdig!

E. N. da C. A.

(1) Grundriss der Cytologie
Von Dr. Lothar Geitler. Pp. viii+296. (Berlin: Gebruder Borntraeger, 1934.) 19.20 gold marks.

(2) Handbuch der Pflanzenanatomie
Herausgegeben von Prof. K. Linsbauer. Allgemeiner Teil: Cytologie (Die Organe der Zelle). Band 2: Allgemeine Pflanzenkaryologie. Hälfte 1: Der "Ruhekern". Von Prof. Dr. Georg Tischler. Zweite Auflage. Pp. xx+630. (Berlin: Gebruder Borntraeger, 1934.) 64 gold marks.

(1) THE number of cytological books is rapidly increasing. The two before us, while both morphological, are almost entirely different in their contents. The work by Geitler aims, on the whole successfully, at giving a statement of the fundamental facts of general cytology, and cites results from plant and animal cells with equal frequency. Its six sections deal respectively with cell morphology, cell division, nuclear division, fertilisation, meiosis, and cytology in relation to heredity. The work is illustrated with 209 figures, some of which are original, a number being photomicrographs. Some of the recent studies of chromosome structures are given, including photographs of the salivary gland chromosomes in the *Simulium* larva. Selected studies are given from the Protozoa, Algæ and other groups of plants as well as the higher plants and animals. This book will serve a useful function as an introduction to the modern problems connected with cytology.

(2) Prof. Tischler's work is a second edition, the first having appeared in 1922. It deals exclusively with the resting plant nucleus, being an exhaustive review with citations of all the relevant literature. The present edition is largely increased in size, the number of publications cited having risen from 1,909 to 3,883, a striking index of the rapid increase in cytological literature. The topics considered are arranged under such headings as the general morphology and chemical organisation of the resting nucleus, the morphology of network, karyolymph, nucleoli, protein crystalloids, the nuclear membrane and exchanges through it, multinucleate cells, and the relation of the resting nucleus to cell division. This volume will be of permanent value as a work of reference.

Experimental Physical Chemistry
By Prof. Farrington Daniels, Prof. J. Howard Mathews and Prof. John Warren Williams. (International Chemical Series.) Second edition. Pp. xix+499. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 21*s*. net.

FOR this second edition the authors have largely rewritten their book; alterations in experimental procedure to give higher accuracy, replacement of less satisfactory methods by new ones, and a different treatment of electromotive force and capacity constitute the principal changes.

In Part I, "Laboratory Experiments", each of the fifteen chapters deals with a particular field of physico-chemical work. The experiments are systematically described, each method being preceded by an adequate explanation of the theoretical principles involved, and followed by a summary of the practical applications of the method and suggestions for further work. Under the heading of Apparatus, Part II deals with means and technique necessary for work of a more advanced nature. These operations are grouped under chapter headings of the subjects to which they are most applicable, the order adopted for Part I being repeated in Part II; this, together with adequate cross-references, gives the book added coherence. Part III is concerned with miscellaneous operations, such as calibration, thermostatic control, the determination and influence of errors, which are of value in the conducting of any detailed systematic investigation.

Though the authors make no claim for completeness, this is a well-proportioned and comprehensive guide for both the student and the research worker.

H. K. W.

Speed*

By Prof. B. Melvill Jones

THE reason why a real fluid can leave the surface is now well understood, but the calculation of the precise point at which it will do so is still a matter of great difficulty, over which we are only just beginning to obtain the mastery. It is still true, in the main, to say that the question whether or not a given body will give a good streamline flow can be determined only by experiment, and it is entirely for this reason that it has been found worth while, in the countries interested in aeronautical development, to spend large sums of money on the construction of huge wind tunnels, within which the necessary experiments can be made. Even in these tunnels the question cannot be settled with absolute certainty, and research workers are turning more and more to face the difficult technique of experimenting in actual flight, to determine how nearly the flow about actual aeroplanes approaches the ideal streamline form.

It is, of course, no easy matter to design and make what may be described as streamline aeroplanes. It is necessary first to eliminate such an obvious obstruction to the air as the undercarriage, by pulling it up into the body or wings when in flight. This involves designing a light and strong mechanism which will return the wheels to the landing position and lock them there with well-nigh absolute certainty. The importance of this point strikes one with added force when landing for the first time upon a collapsible undercarriage which cannot be seen from inside the aeroplane. Next, there is the still more difficult problem of cooling the engines without exposing unstreamline objects to the air stream. The problem is especially difficult with the air-cooled engine which is so convenient in other respects: it has been partly overcome by devices known as the N.A.C.A. cowling and the Townend ring, which are placed around the engine to prevent it from deflecting the air stream away from the surface of the body behind it. Then again the pilot must be able to see forward comfortably through a window which does not spoil the streamline form of the body. This is rather easier when there is no engine in the nose of the body, for the pilot can then be placed well forward in a position where there is less danger of his window causing the stream to separate from the body. Finally, it is necessary to ensure that the junctions between the body and the wings and tail are not such as to lead to unstreamline flow, even though these parts separately would behave in a perfectly streamline manner. It is only recently that reliable information on this point has become available and led to designs in which the wings are carefully moulded into the body.

Until two or three years ago, these difficulties were altogether too much for designers and constructors, with the result that the resistance of the average aeroplane at high speeds was many times greater than it would have been with correct streamlining, and speeds of 100 miles per hour or slightly more were all that could be obtained from the power—one horse-power to about 12–15 lb. weight—usually supplied for transport purposes. During the past few years, the speed of the most advanced forms of civil aerial transport has risen from something less than 100 miles per hour to the neighbourhood of 170 miles per hour—the top speeds of the best aeroplanes have, as everyone knows, risen to more than 200 miles per hour but I am referring to the actual travelling speed. This increase has been primarily due to improvements in streamlining. Secondary developments, such as that of the variable pitch screw and the split-flap wing, have been necessary to enable advantage to be taken of the reduced head resistance without adversely affecting the problem of landing and taking off, but these of themselves could have achieved but little upon the older unstreamline aeroplane.

In the epoch of the imperfectly streamline aeroplane, from which we are only now beginning to emerge, the skin friction on the exposed surfaces contributed so small a fraction to the whole resistance that, even if it could have been eliminated altogether, the speeds would not have increased to any important extent, but, now that it is becoming possible to approach the perfect streamline shape, skin friction provides the dominating contribution to the resistance, and its study with the view of possible reduction of head resistance is transformed from a matter of mainly academic interest to one of supreme practical importance. Here again that curious and insistent urge, which causes the unpractical man of science to study problems for their own sake, without reference to their immediate practical application, has stood us in good stead; for now that skin friction has suddenly taken the foremost place in the

* *Continued from page* 466.

search for still greater speed, we find ourselves already in possession of much useful information about it, although there is still a long way to go before we shall understand its action completely. It is to the consideration of what we already know about skin friction that we must now turn.

A real fluid, such as air, cannot slip over a solid surface; the layers in immediate contact with the surface having no appreciable motion over it. This, of course, is in direct contrast to the ideal fluid of the mathematicians, which is assumed to slip with perfect ease. When one examines the flow of air close to a solid surface, one finds that the velocity parallel to the surface increases very rapidly from zero at the surface to the full velocity of the main stream at a point not far from the surface. The thin sheet of fluid in which this rapid change occurs is called the *boundary layer*. When the flow within this boundary layer is smooth, in the sense that sheets of fluid slip over one another without mixing—like the cards of a pack which is thrown down on a table—we say that the boundary layer is *laminar*, and it is found that when a body, such as a wing, has a smooth surface and a rounded leading edge the boundary layer is smooth—or laminar—for some distance along the surface back from the leading edge. Sooner or later, however, at some point behind the leading edge, this laminar condition breaks down and the flow within the boundary layer becomes *turbulent*, so that the separate sheets of air no longer slip as a whole over one another, but are thoroughly mixed together by the formation of little eddies and erratic movements of small portions of air to and from the surface. Anyone who has looked down over the side of a ship in motion will have seen the effect of this turbulence extending, on a large ship, for a foot or more from the side.

The distance from the leading edge of the wing or the bow of a ship at which the flow within the boundary layer passes from the smooth to the turbulent form is controlled by a number of factors such as the speed of the main flow, the shape and roughness of the solid surface and the turbulence, if any, already in the fluid before it reaches the wing. Speaking roughly, the greater the speed, the greater the roughness, or the greater the initial turbulence of the fluid, the sooner does the transition take place, and although we have a great deal of experimental evidence on the matter, we have, as yet, no means of calculating the distance from the leading edge at which the transition will occur, or even of placing any theoretical limit upon this distance if the surface were perfectly smooth and the main stream perfectly steady.

Experiments made in wind tunnels suggest that at speeds now in contemplation for civil aircraft—say 200 miles per hour—the transition to turbulent flow would be expected to occur within a few inches from the leading edge of the wings and front of the body, so that almost the whole of the surface of the wings and body would be covered by a turbulent boundary layer. But unfortunately there are no large high-speed tunnels yet in existence in which the air stream is as free from turbulence as the open air through which aeroplanes fly; consequently it is to experiments on actual aeroplanes in flight that we must look for a final reliable estimate on this matter. There is as yet very little evidence of this kind available, but the necessary work is in hand.

The practical importance of discovering how far back it is possible to coax the boundary layer to remain smooth will be appreciated from the fact that the skin-friction force exerted by the smooth layer on a high-speed aeroplane would be about one-eighth that of the turbulent layer, so that anything which would increase the area covered by the smooth layer would have a powerful effect in raising the ultimate limit of speed. Assuming, however, for the moment, that it will not be feasible in the near future to retain the smooth form of the boundary layer over more than a small portion of the total exposed surface of an aeroplane, we have to consider the magnitude of skin-friction applied by the turbulent layer.

We have already a considerable knowledge of the skin-friction forces on thin smooth flat plates advancing edgewise into air or water, and we know that on such a plate, as large as the wings of a large aeroplane, the mean skin-friction resistance applied by the turbulent boundary at a speed of 200 miles per hour would be about one-third of a pound per square foot of exposed surface. But, in order to obtain this low figure the exposed surfaces would have to be very smooth. Recent work by Profs. Prandtl and von Kármán has suggested that roughness corresponding to small grains of sand larger than one-thousandth of an inch in diameter, thickly spread over the surface, would appreciably influence the results. Grains, for example, of the order one-hundredth of an inch in diameter would, it is estimated, raise the friction by as much as sixty per cent.

These estimates, it is true, were based only upon experiments made in long pipes with roughened surfaces, and the results were applied to flat pieces of finite length, after elaborate calculations based on unverified assumptions, but, for my part, I believe that the estimates will be found to be substantially correct when checked by direct

measurement on wings of various roughnesses. Such experimental checks should shortly become available from experiments in the compressed air tunnel at the National Physical Laboratory, and from some experiments which we are making at Cambridge to find the resistance of parts of the wings of actual aeroplanes in flight.

As to how far the skin friction on the curved surfaces of a wing or an aeroplane will be the same as that on a flat surface, we are still very much in the dark. The curvature of the wing causes the pressure to change from point to point on its surface, and these pressure changes, or gradients as they are called, influence the flow in the boundary layer and the intensity of the friction applied by it. They also appear to influence the point of transition from smooth to turbulent flow, in the sense that the flow seems more likely to become turbulent when pressure is increasing in the direction of flow. It has long been known that a too rapid pressure rise in the direction of flow reverses the flow in the boundary layer, and is the cause of the separation of flow from the surface of unstreamline bodies; and it now seems that pressure gradients, much smaller than are necessary to cause separation, may still adversely affect speed by encouraging the boundary layer to take on the turbulent form with its inevitably increased resistance. It may be that the impossibility of avoiding such rising pressure gradients over some parts of the surface of an aeroplane will place a final bar upon efforts to extend the laminar boundary layer over the whole exposed surface, but it is as yet too early to make any definite prediction on this question.

We are now in a position to take stock of the situation in respect of the attainment of high speeds by the civil transport aeroplanes of the near future. The most efficient aeroplanes of the present day have travelled a long way towards perfect streamlining, and achieve cruising speeds of a little less than two hundred miles per hour. It has been estimated that if perfect streamlining were to reduce their head resistance to that of a smooth flat plate of the same exposed area with turbulent boundary layer, they would travel some 20 per cent faster than at present on the same power. Hence there is some improvement, though not much, still to be achieved by perfect streamlining.

Now, however, that skin friction has been promoted from the minor role which it played in the pre-streamline epoch to the principal part which it will henceforth play amongst the factors which limit speed, it is no longer accurate enough to assume that it can be represented by the turbulent layer skin friction on a flat plate, and a great vista of research is opened up, of which the object will be to determine accurately the skin friction on the actual curved surfaces of the aeroplane, and to reduce it so far as possible towards the figure appropriate to the laminar boundary layer. Complete success along these lines might result in a further eightfold reduction of direct head resistance, which might correspond to a nearly twofold increase of speed with the same power. One cannot say yet what part, if any, of this great reduction will ever be achieved, for the difficulties in the way of extending the laminar layer appreciably may be very great, and they may prove to be insurmountable. One can only note the reward to be gained if success were complete, and observe that to achieve a relatively small fraction of this reward would be worth a very great effort.

An alternative to the reduction of head resistance would be an increase of power for weight, and no one can predict what new developments of the power units may occur. But to increase speed greatly by this method alone is a difficult matter, for even if the power were to be doubled, by giving to civil aeroplanes powers comparable to those given to-day to war aeroplanes, speed would be increased only by some 25–30 per cent. Personally, I do not look for much increase along these lines in the near future.

There is one other foreseeable way of evading the restrictions on speed, which is much discussed at present, but which has not yet been exploited. This is to fly very high, using totally enclosed aeroplanes within which pressure and temperature can be maintained at a comfortable level for the occupants. By this means, the direct resistance to motion might be decreased almost indefinitely, at the expense of some increase in what I have called the track-laying power, which, as I have shown, places no final limit on speed. Many very difficult practical problems must be overcome before much can be made of this method, and it is too early to give any estimate of the increases in economical speed which might result from this line of attack. Possibly the ultimate limiting factor here will be the difficulty of cooling the engine at these high altitudes.

For my own part, I feel reasonably confident that stratospheric flying, as this high flying is called, with its as yet unpredictable limits to speed, will eventually provide the principal means of long-distance transport over the earth. For I cannot believe that man will fail to take advantage of the arrangement, so conveniently provided by Nature, whereby the air is thick where he has to land and take off, and thin a little way above, where he can travel at high speed with small resistance and without inconveniencing those who remain on the ground.

Surface Chemistry

THE immense progress that has been made in unravelling the details of surface phenomena, since the fifty years old generalisation of J. J. Thomson and Willard Gibbs that the energy conditions at surfaces may profoundly modify not only the concentrations, but also the chemical equilibria at surfaces, were well surveyed on September 6 in a vigorous and crowded discussion held by Section B (Chemistry) at the Norwich meeting of the British Association. The principal speakers were Profs. H. Freundlich, E. Waldschmidt-Leitz, E. C. C. Baly and E. K. Rideal, and Drs. N. K. Adam, A. H. Hughes and J. H. Schulman. Many of the outstanding points in the behaviour of molecules at the principal types of surfaces which occur in systems of actual or potential biological importance were touched upon in more or less detail.

With the simplest kinds of surface film, the unimolecular films at water-air surfaces, the structure is now so fully known that the size, shape, mechanical properties, orientation and motion of the molecules can be discerned in much detail. Links, also, with structural organic chemistry have been made secure by establishing the truth of Langmuir's generalisations that the surface films behave just as would be expected of a layer of floating objects having all the properties of the molecular models of the organic chemist, and that the field of force of the surface is simply the aggregate of the chemical forces round the surfaces of the individual molecules. Fatty compounds and sterols may have any of a large number of different types of film; the molecules may stand upright, or lie flat, or oscillate though various positions, always, however, keeping the water-attracting end to the water. Proteins and the higher carbohydrates lie flat if there is sufficient space on the surface; they may tilt a little if compressed, but never stand upright. With these simple films every stage of compactness is found, from the dilute gaseous films which have the molecules lying flat and swimming about individually in the surface, to the solid condensed films where they are upright, close packed, and interlocked so as to form a two-dimensional polycrystalline structure.

Unimolecular films may, or may not, be actually present as membranes in living cells; but that their properties are of fundamental importance for cell behaviour is already clear. It is possible to imitate, quite closely, on synthetic unimolecular films of substances present in red blood corpuscles, the phenomenon of hæmolysis. Hæmolytic agents introduced into the underlying water cause a great increase in surface pressure, penetrating into the natural film so as to force the molecules apart and cause it to expand, destroying its natural cohesion. Some such penetration and expansion of the membrane round a corpuscle must occur during hæmolysis. Probably agglutination is essentially due to the penetration of substances into the film, the molecules of which orientate themselves so as to render the outer surface more hydrophobic; the attraction of the cell surface for water is thus diminished and the cells tend to clump together.

There is, as yet, no proof that the intrinsic reactivity of molecules is altered merely by adsorption at a *liquid* surface, but nevertheless the surface may greatly affect the chemical equilibrium and the velocity of chemical reaction, through two factors. First, the actual concentration of the molecular species is usually very much altered through adsorption; secondly, the accessibility of the reacting portions of the molecules may be affected by the particular orientation in the surface. For example, the oxidation of unimolecular films of unsaturated fatty acids which have a double bond in the middle of the hydrocarbon chains is much accelerated if sufficient space is allowed on the surface for the chains to lie nearly flat, so that the double bonds can easily come into contact with the oxidising agent in the underlying water; the oxidation is retarded if the film is squeezed so as to push the chains more upright and the double bonds away from the water. Electrolytic dissociation, also, is often affected by adsorption at the simplest kind of surfaces, a phenomenon which may cause indicators to play unpleasant tricks in solutions of colloidal substances. All such phenomena are, however, only effects of the changes in the environment of the reacting groups in the adsorbed molecules, caused by their crowding and special orientation at the surfaces. A *liquid* surface seems incompetent to impose on adsorbed molecules the strains necessary to activate them, and catalyse the variety of reactions which are caused by enzymes and many solid surfaces. But certain colloidal supports can certainly do this.

Enzymes consist essentially of colloidal protein particles, on a part of the surface of which there is a grouping of atoms which has specific adsorptive and activating properties. Substances in the surrounding liquid must both be adsorbed on this

active patch and be activated when there; there must be a highly specific relation between the structure of the active patch and the substrate adsorbed from solution for both these processes to occur. These surface patches do not appear to constitute any great part of the mass of the colloidal particle, for many pure enzymes activating very different reactions are so similar in general composition that ordinary chemical analysis cannot distinguish between them. The enzyme may thus be regarded as a colloidal carrier having a specific local surface structure. The nature of the carrier is of importance, though it is secondary to the nature of the surface grouping; if the carrier is changed the catalytic efficiency of the enzyme may, or may not, be changed. The complex phenomena of activation of enzymes are often due to the combination of two types of particle; and among the most important activators are the sulphydryl grouping and the iron-containing part of hæmoglobin.

The discussion gave a good idea of the progress made by the new science of the molecular anatomy of surfaces; it is well started and cannot fail to develop rapidly and increase in interest and in usefulness to the biologist, and perhaps ultimately also to the practising physician.

N. K. ADAM.

Migrations of Animals

A COMPREHENSIVE discussion which covered the movements of most of the migratory groups of animals occupied the morning of September 10 at Section D (Zoology) of the British Association at Norwich and brought together much recent information about migration and theories concerning it.

The discussion was opened by Prof. James Ritchie, of the University of Aberdeen, who dealt with the migrations of mammals and directed attention to two problems—the cause or causes of migration and the way in which migratory routes were determined. He described briefly the well-known large-scale movements of such as the lemmings in Scandinavia, the brown rats which invaded Europe from the Caspian region in 1727, the grey squirrels and martens in North America before 1866. These, due to lack of food following undue multiplication, were casual, rather sporadic, one-way movements—overflow movements and not migration proper, and they aimed at no definite goal. True migrations, regular seasonal goings and comings or two-way movements, are of two types, differing in degree rather than essence. The local migration, shown by the red deer of Scottish hills or the Wapiti deer of the Yellowstone Park in the United States, was a movement from summer feeding grounds at high altitudes to a winter range in the shelter of the valleys. Its primary urge was food.

The great seasonal migrations, impressive in extent as well as in the mass of animals taking part in them, were formerly represented by the movements of the wild horses of the steppes of Asia, of the countless antelopes of Africa, the bison, reindeer and musk-oxen of America. They were determined mainly by scarcity of food, though other 'hungers' for water or for salt, also induced regular migrations; and their route often followed regular tracks or roads surveyed and made by far distant ancestors after trial and error towards a definite goal. Road-making is characteristic of the daily activities of mammals, and migratory tracks formed a heritable property handed down fro generation to generation. Such an explanation migration avoids the need of invoking any sp migratory instinct or special sense of direction.

Dr. N. A. Mackintosh described the migrations of whales from the antarctic region where they are most abundant during the summer, gorging upon the crustacean *Euphausia superba*. In winter they move northwards to temperate waters for the breeding season, and although actual migrations have not been often traced, the circumstantial evidence is strong. For example, in the antarctic, whales fatten enormously as the summer advances, and then off South Africa whales very fat in body and yet with empty stomachs are found, clearly immigrants from the antarctic feeding grounds. Again in winter off the African coast whales bearing fresh scars were found, but when whales were caught in the antarctic the scars were healed —they had been contracted in warmer waters during the northern migration. How the migrating whales are guided on their movements is not clear: except in coastal waters landmarks seem to be out of the question, but perhaps the temperature of the water controls the movements, since the regular presence of whales seen from the *Discovery* in the antarctic shows that they frequent tongues of warm water and are obviously sensitive to temperature.

Recent discoveries regarding the migrations of birds were described by Dr. A. Landsborough Thomson, who pointed out that the old idea of narrow migration routes along coast-lines and river-valleys had been abandoned in favour of the

idea of migratory movements upon a broad front. The extraordinary complexity and variety of migration in different species, sometimes closely related, were illustrated by a series of well-chosen examples, some selected from the recently investigated movements of birds confined to tropical areas; but it was pointed out that overriding all the complexities a regularity of time and place and route characterises migratory movements as a whole. The outstanding problem still to be solved is that of route-finding, and although there are many indications that vision plays an important part (for example, fog is one of the serious disturbances of a migration) yet the orientation of a migration journey must still be looked upon as something of a mystery.

Some interesting results of marking experiments were described by Dr. E. S. Russell in discussing the migrations of fishes, where knowledge of migration is of great economic importance since the movements of concentrated shoals of food fishes regulate the fisheries. In fish-marking experiments, hundreds of thousands of individuals have been marked and a high return of 30–40 per cent gave a clear indication of the major movements, which was supplemented by the analysis of fishery statistics. Generally speaking, the migrations of fishes consist of three movements—of mature fish to the spawning grounds, generally upstream, a dispersion after spawning, generally downstream, and local seasonal migrations such as that of the tunny into the North Sea in autumn. Dr. Russell illustrated these facts by describing in detail recent observations upon the movements of cod, plaice and salmon.

The series of general papers on migration was concluded by an account of the migrations of insects by Dr. C. B. Williams. In this case, migration does not necessarily include a return flight, though in the last five years evidence has accumulated that some Lepidoptera do make a return journey. Migration is widespread in the insect world, many instances being known from the groups of Lepidoptera, locusts, dragon-flies and beetles. One of the most remarkable cases is that of the American monarch butterfly which spends the summer so far north as Alaska and winters in the southern States and Mexico, returning to a state of semi-hibernation in the same groups of trees year after year, although one or two generations have passed since the former occupants had traversed the migration route. The extraordinary movements of the world-wide painted lady butterfly were described, and it was shown that insect migration takes place in definite directions, and is independent of the direction of the wind. The understanding of insect migration is complicated by the short life of insects which makes impossible any learning of the route from direct ancestral experience.

The migration symposium was a popular feature of the Section's discussions, and was attended by a very large audience.

Character and Causes of New Stars

AT the British Association meeting in Norwich, a discussion on new stars was opened in Section A (Physics) on September 10 by the Astronomer Royal (Dr. H. Spencer Jones), and other papers were contributed by Mr. J. P. M. Prentice, Prof. F. J. M. Stratton, Prof. W. H. McCrea, Mr. E. G. Williams, and Dr. A. B. Wyse and Mr. R. H. Stoy. The following is a summary of some of the chief points which emerged.

A new star may be defined for practical purposes as a star the apparent brightness of which increases within a few days by some five magnitudes or more. The first well-authenticated historical record of a nova is of that observed in 1572 by Tycho Brahe, and since then novæ have been looked for and observed with increasing zeal. This may be illustrated by the fact that, since 1901, forty-two galactic novæ have been recorded, and of these seven have been near enough and discovered soon enough for detailed spectroscopic study. These seven include Nova Herculis 1934, discovered by Prentice, through whose promptitude in communicating the fact a spectrum was obtained by Martin at Greenwich within one hour after discovery.

The 'light-curve' of a nova in general shows a steep rise to its principal maximum, followed at first by a steep fall, and then by a more gradual fading, with small fluctuations, to something very near the pre-outburst magnitude. The case of Nova Herculis, however, showed novel features in the way of many comparable maxima, extending over some months, before the steep drop occurred. The intrinsic surface brightness, as judged by the effective temperature, does not in general change much before the principal maximum, and hence the increase in total brightness must be attributed to an increase in the radiating surface. In a typical case, the radius of the star, as defined by its photosphere, must increase about a hundred-fold. In the later stages, however, the effective temperature does increase very considerably, so

that the final radius when the star has returned to approximately its initial total brightness may be perhaps 1/25 of the pre-outburst radius. The net consequence of the outburst being thus a contraction of the whole star, it results in the liberation of a vast amount of gravitational energy of which some, at any rate, must supply the energy for the increased radiation during the eruption.

The variation of brightness of a nova is accompanied by a highly complex sequence of changes in its spectrum. Before the principal maximum the spectrum is not greatly different from one of the ordinary spectral types. The absorption lines, which are then its chief feature, show by their displacement towards the violet the general swelling up of the star already deduced from its increase in brightness. After maximum, multiple absorptions appear with large violet displacements, and each in general bordered on the redward side by bands of emission the mean position of which coincides in each case with the undisplaced position of the corresponding spectral line. These features can be explained by supposing that one or more shells of gas are thrown off from the star and accelerated away from it, probably under forces due to radiation pressure. This has in some cases been confirmed by the fact that, after enough time has elapsed for these shells to attain sufficient size, it has been possible to observe them directly as a growing nebulosity around the parent star. There is also spectroscopic evidence in some cases for the ejection of matter in irregular jets rather than, or as well as, in symmetrical shells. In addition, turbulence appears to develop in the ejected matter.

In the further spectral development the absorptions gradually disappear, giving way to a bright line spectrum in which a number of 'forbidden' lines of oxygen [O I] and [O III], and iron [Fe II], make their appearance. The whole sequence is consistent with what may be expected from the increase of temperature of the parent star and the decrease in density of the expanding envelope. The final spectrum is of Wolf-Rayet type, the structure of the lines suggesting the continued emission of gas. It seems probable that the nova is then approaching a white dwarf state.

Photometric measurements of novæ spectra have recently yielded valuable information confirming both the hypothesis of the expanding gaseous shells and also the high colour temperature attained by the nuclear star in the later stages. Further, the photometry of the absorption lines due to interstellar Ca^+ yields an estimate of the distance of the nova. This method gave for Nova Herculis a distance of 1,200 light-years, which shows that at maximum it was 30,000 times as bright as the sun.

The estimated rate of appearance of novæ in the Milky Way agrees well with Hubble's estimates of the number appearing in the Andromeda nebula, which may be regarded as a comparable system. If this rate is assumed uniform, it shows that in about 3×10^9 years every star would become a nova. This is approximately equal to the lowest estimate of the age of the stars, so it seems likely that such a flare up may in fact happen to every star. The most plausible explanation of the phenomenon is provided by E. A. Milne's theory, according to which instability sets in at a certain epoch in the evolution of a star, causing it to pass over into a 'collapsed' configuration, with the liberation of a large amount of gravitational energy. The same theory shows that, if the star is originally rotating, the collapse may cause it to split into two components, which need not then remain collapsed, thus suggesting an origin for double stars.

It is extremely doubtful whether novæ constitute a homogeneous class of objects. Whereas the total brightness in most cases increases ten- or a hundred-thousand fold, it seems that the nova of 1572 underwent an increase of about 16 million fold. Similar cases have been observed in other galaxies. So the isolation of a class of *super*-novæ is indicated, and it has been suggested by Baade and Zwicky that their outbursts provide the source of cosmic radiation. Again the behaviour of stars like RS Ophiuchi and T Pyxidis makes it seem probable that there is also a class of *recurrent* novæ.

W. H. McC.

Geological Relations of Early Man in East Anglia

THE discussion on this topic, held on September 5 at the Norwich meeting of the British Association, has revealed a far greater measure of agreement between geologists and archæologists than has emerged during any previous review of the subject. The division of the East Anglian glacial deposits into four distinct groups has provided a framework into which most of the archæological finds appear to fit quite naturally; it is thus not surprising that discussion should now centre around the more obvious of the remaining doubts and difficulties.

The first of these concerns the authenticity and cultural position of the various sub-Crag industries.

The best pieces from this horizon are now fairly generally accepted as human, both by geologists and archæologists; but some enthusiasts among the latter are apt to spoil their case by the obstinate advocacy of a great deal of poorer material which, convincingly human as it may be to their experienced eyes, can scarcely be expected to impress geologists who lack their special knowledge of these early industries. In any event, it is becoming increasingly clear that no general agreement can ever be obtained as to the exact position of the beginning of the Stone Age; but it seems justifiable to record a majority of informed opinion in favour of the human origin of some at least of the flints found below the East Anglian Crags. Some archæologists claim to recognise a Chellian facies in these cultures; but there are not many who would support their reference to the Chellian as usually recognised at present.

The next difficulty is the determination of the geological position of the true Chellian culture. This is largely due to the occurrence of a depositional hiatus between the first ('North Sea') and second ('Great Eastern') glaciations. Further, with the exception of one implement found by Mr. J. E. Sainty in the North Sea Drift, all the known Chellian specimens from East Anglia are heavily abraded, and are clearly much older than the deposits in which they are now found. Mr. Sainty's implement appears to indicate a preglacial date for the industry, and this accords well with its occurrence at Abbeville in association with a Cromerian fauna; but in that case it was probably of very long duration, since the Acheulian industry does not appear in England until after the second glaciation. It is to be hoped that further study of the deposits belonging to the first interglacial period, such as occur in the Midlands, will provide some help towards the solution of this problem.

The Acheulian of East Anglia appears to belong entirely to the second interglacial period. The only possible exceptions are provided by a few pieces found by Mr. J. Reid Moir in the so-called 'Upper Chalky Boulder Clay' and associated gravels in the Ipswich district. But as this 'Upper' boulder clay is no more than a surface modification of the great sheet of Chalky Boulder Clay which covers most of Norfolk, Suffolk and Essex and is known to underlie the Acheulian brickearths at Hoxne and at Derby Road, Ipswich, it seems reasonable to regard Mr. Moir's specimens as having reached their position from the surface; this could be explained either by later solifluxion or by descent into frost cracks.

It is now generally accepted that the flake industries of Clacton and High Lodge were broadly contemporaneous with the Acheulian, although the exact parallelism of their various stages has not yet been fully worked out.

The deposits of the third ('Little Eastern') glaciation frequently contain Acheulian and Clactonian implements. They have long been known from Gresham on the Cromer Ridge and from the gravels of the Breckland; Mr. Sainty has recently been finding them at several new localities in West Norfolk.

The archæological history of the third interglacial period is a matter of doubt. Apart from a few scattered Upper Palæolithic finds, the prevalent culture belonging to this interval is a curiously mixed assemblage suggestive of a degenerate Levalloisian or even Clactonian industry with traces of Upper Palæolithic influence. As it occurs largely on surface sites of no stratigraphical value it has been somewhat summarily referred to the Neolithic by many archæologists, in spite of the fact that real Neolithic forms and technique are wanting. Mr. Reid Moir's 'Lower Floor' at Bolton's pit, Ipswich, represents this industry; it is also known from Morston in Norfolk and is probably found on many surface sites in the Breckland.

It is to be hoped that archæologists will make a detailed study of this industry, which has certain well-marked peculiarities of technique and is probably peculiar to Great Britain.

The mesolithic industries are never found in glacial deposits even where the fourth glacial period is represented, and they are therefore considered as entirely post-glacial.

Such is the state of our knowledge of these problems as revealed by the recent discussion. Other points raised were the questions of nomenclature, of the position of the Pliocene-Pleistocene boundary and of the possibility of making a detailed chronological Drift map for the assistance of the archæologists.

Prof. P. G. H. Boswell suggests that the suffix '-ian' should be uniformly adopted for all the Palæolithic industries; this would appear to be logical and to follow the standard practice of British geology. The question of the Plio-Pleistocene boundary would eventually have to be settled by international agreement, but meanwhile there would seem to be a strong case for following the palæontologists, who place it at the horizon of the appearance of *Equus*, *Bos* and *Elephas*; that is to say, below the Red Crag of East Anglia.

The possibility of a detailed Drift map would seem to be small until the Pleistocene sequence has been correlated over the whole country; archæologists will therefore have to rest content with the ever-increasing number of criteria provided by the geologists for the differentiation of the various Drift deposits. J. D. SOLOMON.

Lubrication

AT a joint meeting of the Sections G (Engineering) and A (Physics) of the British Association in Norwich, on September 9, several problems in connexion with lubrication were discussed.

The field of lubrication may be regarded from several points of view. In the first place the design of bearings of different types for various species of mechanism presents a number of novel mathematical and engineering difficulties several of which, especially in reference to the thrust bearing, were considered at the meeting.

A suitably designed bearing will make the best use of the lubricating medium, which must be automatically entrained, rejected and replenished by the action of the bearing itself.

Whilst it is satisfactory to note that there has been during the last few years a very marked improvement in the design of bearings and in the methods and materials of their manufacture, it is equally clear that progress is not nearly so rapid in the second field of inquiry, namely what constitutes a good lubricating oil. This problem becomes daily more acute, for, as emphasised by more than one speaker, the modern development of the aero engine necessitates efficient lubrication at increasingly higher temperatures.

It has, of course, long been recognised that bearings design and materials, load, speed and temperature are all important factors which influence the frictional loss when any one lubricant is employed. It is very satisfactory to note that a number of testing machines are now available in which these factors can be varied independently.

It is unlikely that testing machines of different types will place a series of lubricants in identical orders of merit. If it be accepted that the duties of a well-designed bearing is to replenish oil at least as rapidly as it is consumed, it is necessary to inquire into the factors which cause consumption of oil and the nature of the products of destruction. Presumably a bearing may fail or record a high frictional loss, not on account of undue oil consumption but through insufficient entrainment of fresh oil, a fault which may be due either to the mechanical design of the bearing or to the physical properties, especially the fluidity, of the oil itself, or to a combination of both these factors. It would appear that some time must elapse before testing machines are devised which permit us to segregate the intrinsic characteristics of lubricating oils such as life or stability, oiliness and other more well-defined properties without reference to the type of bearing.

In respect to the mode of operation of the lubricant in boundary lubrication, the thesis of the late Sir William Hardy comprised two separate hypotheses. First, that a lubricant had to contain a substance capable of forming a monolayer on the metal anchoring itself by means of a polar group to the bearing surface and presenting to the liquid interface a long non-polar chain. Secondly, that above this monolayer a relatively thick orientated film was formed, termed diachysis by Hardy, a phenomenon which apparently bears a resemblance to the so-called cybotactic properties of certain liquids.

Both industrial and research experience have proved the correctness of Hardy's first assumption, but the weight of experimental evidence is now definitely against Hardy's hypothesis of a diachytic chain as possessing any real existence in a warm and moving bearing containing a fluid lubricant.

At the same time it is evident that the simple addition of say a long chain acid to a normal paraffin is not sufficient to produce the ideal lubricant although the orientated monolayer is formed under these conditions.

Two important factors have to be taken into consideration: first, the life of a monolayer is not indefinite, indeed, there is now evidence to show that one single passage of a slide over a surface lubricated with a monolayer is sufficient to destroy the lubricating properties of the layer. It follows that the bulk of the oil must be so constituted that it can act as a reserve for the rapid supply of fresh molecules to form the monolayer.

The rise of surface temperature, which may be surprisingly high, up to the melting point of the metal, has two important consequences: first, the distribution of the lubricating semi-polar molecules between the surface and the bulk phase, if controlled by a Boltzmann distribution, will be unfavourably affected, and secondly substances prone to thermal or oxidative chemical reactions will be destroyed. Whilst little is known about the rates of such disarrangements and chemical reactions in actual bearings, electron diffraction photographs reveal the non-uniform nature of the surface, and it is not surprising that attempts are being made to improve lubricants by the addition of polymeric and micelle-forming substances which are stable towards oxygen, less readily desorbed and renewed when destroyed at rates greatly superior to the long chain fatty acids.

E. K. R.

Obituary

Dr. Peter Giles

WE regret to record the death of Dr. Peter Giles, Master of Emmanuel College, Cambridge, and distinguished philologist, which took place in Cambridge on September 17 at the age of seventy-four years.

Peter Giles was born at Strichen, Aberdeenshire, on October 20, 1860, and after graduating at the University of Aberdeen, he went up to Cambridge as a scholar of Gonville and Caius in 1882. He was placed in the first class in both parts of the Classical Tripos and in the second class in history; and he won a number of University prizes. He was elected a fellow of Caius in 1887; but in 1890 he migrated to Emmanuel, and in 1891 was appointed reader in comparative philology in succession to Dr. Peile. In 1911 he became Master of his college. Throughout his academic career he fulfilled the many duties in College and University to which he was called, with conspicuous success by the exercise of qualities which won him the affectionate respect of all with whom he came into contact.

Giles's influence in the study of comparative philology began to be felt when the exuberant enthusiasm aroused by Max Muller's early teaching was waning under the cold breath of criticism. His "Short Manual of Comparative Philology for Classical Students" (1895) introduced a new and saner method to British scholarship. Nevertheless it was only very slowly that philology came to be regarded as anything but a highly specialised and circumscribed study, which could contribute little to the analysis of the broader aspects of cultural development which absorbed the attention of archæologist and ethnologist. Here again it was the influence of Giles and his writings, and more especially his contributions to Hastings's "Encyclopædia of Religion and Ethics" and the Cambridge Histories, that did much to restore a truer sense of balance and proportion. The brilliance and sanity of his discussion of the Aryan problem, as well as the convergence of his views towards lines which were being traced by archæological research, once more directed attention to a body of evidence which, with due recognition of its limitations, students of the origins of European culture could no longer afford to neglect.

Mr. T. H. Riches

THE death of Mr. Thomas Henry Riches, on September 19, at the age of seventy years, will be much regretted by his many scientific friends. As an undergraduate at Caius College, he was much interested in zoology, and after taking his degree in 1888, he devoted some time at Plymouth to the study of the Nemerteans. Here he published an account of the local forms, and collected material for elucidating the embryology of *Cephalothrix*; though before this work could be brought to satisfy his critical and rather fastidious mind, the burden of wealth was thrust upon him and he had perforce to turn his attention elsewhere.

Throughout life, however, Riches kept in close touch with zoological developments, and when experimental heredity became prominent he embarked on breeding research with rabbits—continuing it for a number of years. Though here again he published nothing in his own name, he discovered many interesting facts which, through the medium of others, were ultimately incorporated into our standard knowledge of the genetics of this animal.

More recently, Riches undertook an investigation into the genetics of the form of achondroplasia which appears as 'bull-dog calves' in Dexter-Kerry cattle, and of the analogous monstrosities in the Scandinavian Telemark breed, and these experiments were in progress at the time of his death. Art claimed his interest as well as science, and probably many readers of NATURE will remember him as a generous benefactor to the Fitzwilliam Museum and other good causes.

THE death has occurred in Berlin of Dr. Lydia Rabinowitch-Kempner at the age of sixty-three years. She was born at Kovno in Lithuania and studied medicine at Zurich and Berne and then in Philadelphia, where she taught in the Women's Medical College during the winter, and in the summer frequently carried out researches in Koch's laboratory in Berlin. Her first scientific work to attract attention was on the presence of non-pathogenic acid-fast bacilli in 60 per cent of the specimens of butter examined in Berlin. She then devoted her attention to tuberculosis and published articles on avian tuberculosis, spontaneous tuberculosis in domestic animals, hereditary transmission of tuberculosis in birds, etc. She also carried out researches on trypanosomiasis with Koch and on plague with Walter Kempner, another of Koch's assistants, whom she married. In 1912 she was the first woman to obtain the title of professor for scientific work. For some years prior to the anti-Semitic campaign in Germany she was editor of the *Zeitschrift für Tuberkulose* and director of the Bacteriological Department of the Moabit Hospital, Berlin.

WE regret to announce the following deaths:

Prof. Max Cremer, emeritus professor of physiology in the University of Berlin, and formerly head of the Physiological Institute of the Veterinary College, Berlin, aged seventy years.

Prof. A. Guntz, professor of applied chemistry in the University of Algiers, and *correspondant* of the Academy of Sciences, Paris.

News and Views

Dr. Arnold Berliner and *Die Naturwissenschaften*

WE much regret to learn that on August 13 Dr. Arnold Berliner was removed from the editorship of *Die Naturwissenschaften*, obviously in consequence of non-Aryan policy. This well-known scientific weekly, which in its aims and features has much in common with NATURE, was founded twenty-three years ago by Dr. Berliner, who has been the editor ever since and has devoted his whole activities to the journal, which has a high standard and under his guidance has become the recognised organ for expounding to German scientific readers subjects of interest and importance. A personal friend of Dr. Berliner writes: "When addressing the editor on his seventieth birthday in the inaugurating page of a festival issue, Albert Einstein said, 'His journal cannot be imagined as absent from the scientific life of our time'. Extremely small, indeed, is the number of journals which fulfil the task of uniting by a strong bond the separated and highly specialised work of the leading students in the various domains of science. The editor's important rôle and his active contribution to the progress of research, in conducting a periodical of this kind, are of a different order of magnitude from that of an ordinary 'Fachzeitschrift'. In order to cope with his task, he is obliged to exert very definite leadership on a body of prominent men, everyone of whom is liable to see things distorted from the point of view marked by his own interests and achievements. The editor is the one who has to survey the broad stream of scientific development, to select which subject-matters are suitable for presenting to his readers, to have intimate knowledge of the abilities (scientific and otherwise) of his contributors and, finally, after deciding upon the best writer upon a particular subject, to coax him into fulfilling towards his colleagues a duty of which sometimes neither he nor they are aware and to which the man himself often feels little inclination. It would need a large volume (and, maybe, more than one) to embody only those first-class essays which would never have been written, had it not been for the impossibility of resisting our dear and esteemed friend's gentle command".

Centenary of Darwin's visit to the Galapagos Archipelago

ON September 16, 1835, in the course of the voyage of the *Beagle*, a call was made at the islands of the Galapagos archipelago in the Pacific. This visit was one of the most momentous incidents in the life of Charles Darwin, who was on board the ship as naturalist, for the observations which he was enabled to make gave that orientation to his thoughts which ultimately led him to formulate his theory of the evolution of species. He records in his diary: "The natural history of these islands is eminently curious and well deserves attention. Most of the organic productions are aboriginal creations, found nowhere else; there is even a difference between the inhabitants of the different islands; yet all show a marked relationship with those of America, though separated from that continent by an open space of ocean between 500 and 600 miles in width. The archipelago is a little world within itself, or rather a satellite attached to America, whence it has derived a few stray colonists and has received the general character of its indigenous productions. Considering the small size of these islands, we feel the more astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period geologically recent the unbroken ocean was here spread out. Hence both in space and time, we seem to be brought somewhat near to that great fact —that mystery of mysteries—the first appearance of new beings on this earth."

Galapagos Exhibition at the Natural History Museum

To commemorate Darwin's visit to the Galapagos archipelago, a selection of the more characteristic forms of the reptiles and the birds, which were the elements of the fauna that especially claimed Darwin's attention, is exhibited in the Reptile Gallery of the British Museum (Natural History), South Kensington; some of the specimens, indeed, were collected by Darwin himself. Series of mocking-thrushes (*Nesomimus*) and finches (*Geospiza*) are arranged to show the variations in structure and distribution which are described in the "Journal of Researches" and which have puzzled ornithologists ever since. The characteristic giant tortoises, and marine and terrestrial iguanas are also shown, and attention is directed to the destruction of the fauna during the past century and to the imminent danger of its disappearance owing to the introduction and uncontrolled spread of predatory domestic animals.

Darwin and H.M.S. *Beagle*

THE president of the British Association, Prof. W. W. Watts, has received from H.M.S. *Beagle* a cablegram, recalling the centenary of Darwin's landing from the former *Beagle* on the Galapagos Islands. This important event in the history of biological science was duly noticed at the recent meeting of the Association in Norwich. (See NATURE of September 14, p. 426.) The cable pays tribute to "our most distinguished passenger", and adds that "the present *Beagle* salutes the British Association, the trustees of science". An appreciative acknowledgment, wishing good luck to the present *Beagle*, has been returned.

Bicentenary of James Keir, F.R.S.

ON September 29 occurs the bicentenary of the birth of James Keir, an able chemist and the friend

of Erasmus Darwin, Boulton, Watt, Priestley and Davy. The youngest of a family of eighteen and born in Stirlingshire, after attending the High School and University of Edinburgh he entered the Army and afterwards served for several years in the West Indies. Resigning his commission in 1768, he settled in the Midlands, became connected with various industrial enterprises and devoted himself to chemistry and geology. He was in turn a glass manufacturer at Stourbridge, an assistant to Boulton and Watt at Soho and the founder, with Alexander Blair, of a soap and alkali works. With Blair, too, in 1794 he opened the Tividale Colliery. In 1776 he translated Macquer's "Dictionary of Chemistry" and in 1777 published a treatise on elastic fluids or gases. He also contributed chemical papers to the Royal Society, and in 1785 was elected a fellow. A chemical dictionary of his own, of which he published the first part in 1789, he discontinued on his becoming convinced of the weakness of the phlogiston theory. For many years he lived at West Bromwich, where he died October 11, 1820, at the age of eighty-five years.

Adam Politzer, 1835–1920

ADAM POLITZER, one of the principal founders of otology, was born at Alberti in Hungary on October 1, 1835. He studied medicine in Vienna under Skoda, Rokitansky, Oppolzer and C. Ludwig, and qualified in 1859. In 1861 he was appointed lecturer in otology, and during the following years held a number of appointments in the University of Vienna connected with his speciality, being elected professor of otology in 1895 and director of the otological clinic in 1898. In addition to a textbook on otology first published in 1878, which ran through many editions and was translated into English in 1883 and 1902, he was the author of numerous articles on the anatomy and physiology of the ear and its diseases, especially suppurative otitis media and polypi. In 1864 he helped to found the *Archiv fur Ohrenheilkunde*, and in 1895 the Austrian Otological Society. The Vienna ear clinic possesses a rich collection of anatomical and pathological specimens of the ear prepared by him. His name is attached to a method of inflation of the middle ear through the Eustachian tube by a pear-shaped rubber bag introduced through the nostril. He died in his eighty-fifth year on August 10, 1920.

Louis Ranvier, 1835–1922

LOUIS ANTOINE RANVIER, the eminent French histologist, was born at Lyons on October 2, 1835. His medical education took place in Paris, where he qualified in 1865, and two years later became Claude Bernard's assistant at the Collège de France. In 1875 he was appointed to the chair of general anatomy in the Paris faculty of medicine, and held this appointment for more than thirty years. In 1886 he was elected a member of the Paris Academy of Medicine and in the following year a member of the Academy of Sciences. He also became a member of numerous foreign academies and learned societies. His principal works are the "Manuel d'histologie pratique", written in collaboration with Cornil (1869–76) and his "Traité technique d'histologie" (1875–82). He made numerous contributions to the proceedings of the Société de Biologie and Academy of Sciences, and published a large number of papers in the *Journal de l'Anatomie et de la Physiologie*, *Archives de Physiologie*, *Journal de Micrographie*, etc. The term 'Ranvier's nodes', which is familiar to every biological student, has been given to the annular constrictions of the neurilemma associated with discontinuity of the medullary sheath of the nerve fibre. Ranvier died on March 22, 1922, in his eighty-seventh year, at Vendranges, Loire, where he had been living in retirement for some years.

'Legislative Anthropology'

DR. ARTHUR MACDONALD, of Washington, D.C., and formerly fellow of Johns Hopkins University, is well known for his advocacy of the claims of 'legislative anthropology', that is, study of the legislative, political, psychological, sociological and physical status of members of a legislature or parliament. He holds that as chosen servants of the people, members of the United States Legislature, for example, coming from all sections, are truly representative, and afford a good opportunity of establishing the anthropological status of the country. He goes further and argues that a similar study in other countries would afford a basis for comparison as between nations. At present, his opportunities are confined to material from the United States. He has made a study of certain physical characters of eighty-nine members of Congress, of which the results were published in the *Congressional Record* of the Seventy-second Congress, First Session, under date May 11, 1932. The figures then given established some interesting correlations, especially when studied in their geographical distribution according to States. Dr. Macdonald has now instituted some interesting comparisons between these members of Congress and a number of the insane, although he admits that the latter have no distinctive physical character. The number of individuals measured in this category was 360. They were chosen for their intelligence and included ex-army and naval officers and professional men. The majority, however, had no more than common school education, and for the most part had practised trades. The following are some of the measurements: *Congress*—length of head, 196 mm.; breadth of head, 156 mm.; height of head, 139 mm. *Insane*—length of head, 190 mm.; breadth of head, 151 mm.; height of head, 139 mm. It is to be noted, however, that while stature and weight in members of Congress are respectively 177 cm. and 183 lb., in the insane they are 170 cm. and 150 lb. Obviously the figures need further analysis before any significant conclusion can emerge.

An Education Film—"Northern Lights"

THE sound film entitled "Northern Lights" seen recently at a private view at the offices of the Western Electric Co. at Bush House, Aldwych, London, W.C.2,

is the film record of the expedition that set sail from the Port of London in July, 1930, in the late Sir Ernest Shackleton's old ship the *Quest*, under the leadership of Gino Watkins, to explore the possibilities of an air route between England and Central Canada. It is now available under the Western Electric Company's "All-in" Hiring Service, under which films, equipment and operators can be hired under one inclusive hiring fee, and is the latest addition to a series of educational films specially suitable for schools, that includes "Climbing Mount Everest" and "With Byrd at the South Pole". The photography is of a high standard, particularly in view of the trying conditions under which much of it was done. Particularly impressive was the record of a blizzard at the Expedition's base on the east coast of Greenland, views of the driving clouds of snow on the mountains being followed by others showing the subsequent gale in the fiord, which averaged 80 miles-an-hour and reached 120 miles-an-hour in gusts. Through the spindrift could be seen the floes of ice being hurried out towards the open sea, and the whole effect, combined with the accompanying sound record of the shrieking of the wind, was extremely impressive. There were glimpses also of the Eskimos and their kayaks, and of the members of the crew learning to use these vessels for the purpose of hunting seals, and finally of actual seal hunts. A good idea is given of the laborious sledge journeys in melting snow, and on ice slopes, and of the part played by the dogs—huskies from the west coast of Greenland. The educational value of the film is considerable, and it should prove very entertaining, as well as instructive, at schools.

Extension of Messrs. Negretti and Zambra's Works

MESSRS. NEGRETTI AND ZAMBRA, whose high reputation for scientific and industrial instruments is well known, have just completed a fourth extension of their works consisting mainly of a double floor building of approximately 10,500 square feet. The first floor comprises a new electrical thermometer department and experimental department with an extension for aircraft instruments. In the assembly of certain electrical thermometers it is very desirable to have a dust-free atmosphere, and very special care has been taken to ensure cleanliness in this department. For this purpose, an air-conditioning plant is installed which supplies the shop with filtered air, and if required, heated air free from dust and dirt. The air is led through a comparatively large duct along the roof and into the shop through adjustable nozzles placed at intervals along one side of the building. As the whole building is practically air-tight, a series of exhaust fans are provided in the window frames on the opposite side of the shop for exhausting the air. This ensures a flow of pure air across the shop with no entry of impure air. Consideration has also been given to the flooring to avoid dust, and this is a wood block floor of Austrian oak. The test room is separated from the main shop by partitions, and this is likewise kept dust-free. The equipment of the test room includes standard potentiometer, millivoltmeters, thermometer-testing baths, etc. The expansion has resulted also in an enlargement of the existing machine shop and a further expansion for the manufacture of mercury-in-steel thermometers.

Archæological Investigations in Shansi, China

RECENT excavation and an archæological reconnaissance in the province of Shansi, China, by Mr. C. W. Bishop, associate curator of the Freer Art Gallery, Smithsonian Institution, Washington, D.C., have made possible a remarkably detailed reconstruction of the late neolithic culture of north China. In an interim summary report of the results issued by the Smithsonian Institution, it is stated that the human skeletal remains discovered indicate that in the main the prehistoric population is identical with that which occupies the country to-day. A village site, which was excavated, was found to consist of beehive-shaped pit-dwellings, about ten feet deep, which were entered from the top. The present inhabitants of the district live in dwellings excavated in the cliff face, sometimes in two or more tiers, the entrance being in front. The prehistoric villagers were settled agriculturists, with the dog and pig as their only domesticated animals. They cultivated their fields with a stone hoe. They wore woven clothes, as well as using bark-cloth, and must therefore have been acquainted with some plant affording fibre for textiles. They also wore skins and furs; and they wove baskets and mats. Their implements were of stone, bone, deer antler and, no doubt, wood. Adzes, axes and knives, both rectangular and semi-lunar, often perforated, were found, as well as arrow points of stone, bone and shell. Although immense quantities of potsherds were found, there were few complete vessels. It is interesting to note that the pottery falls into two classes, of which the earlier was hand-made (coiled) and the later, falling at the end of the stone age, was painted. The hand-made pottery was decorated with impressed, incised or applied ornament; the painted pottery shows a buff or red-brown ground, on which geometric designs were painted in black, red or white. There is evidence of human sacrifice, and possibly of ritual cannibalism. This culture precedes the Chinese Bronze Age, which is known to have begun some centuries before 1500 B.C.

Bureau of American Ethnology

FOLLOWING the precedent of last year, the fifty-first annual report of the Bureau of American Ethnology is reduced in size and does not include the "Accompanying Papers" describing the field-work of the staff, which for so long have made this publication year by year one of the most important contributions of the United States to the literature of anthropology. The fifty-first report covers the operations of the staff of the Bureau in office and field up to June 1934. In the interests of economy, field-work was much curtailed, and for the most part took the form of supervision of the archæological investigations which have been put in hand in the States of

Tennessee, Georgia, Florida and California by Federal authority as part of the measures under the Civil Works Administration for the relief of unemployment. Of these investigations, the most extensive were in California, where extensive excavations at the Buena Vista Lake, Kern County, under Dr. H. D. Strong and Mr. W. M. Walker revealed evidence of extensive occupation and some six hundred interments. Nearly 5,000 artefacts and specimens were obtained, as well as information which throws a flood of light on the prehistoric inhabitants of the great southern valley of California and their ethnic affiliations. Mr. J. N. B. Hewitt's study of the Iroquois continues to reveal new and interesting details in the organisation of the Confederacy of the Five Nations, and this year promises to be of exceptional importance to the student of Indian tribal relations. Incidentally, the report shows another side of recent political 'scandals', alleged in criticisms of unemployment relief, by a reference to the specially qualified unemployed who were engaged to translate or transcribe material from the Bureau's archives hitherto inaccessible to study, or in danger of perishing.

British Hardwoods

IN a paper entitled "Our British Grown Hardwood Trees", read before the Forestry Sub-section of Section K (Botany) at the meeting of the British Association in Norwich on September 5, Mr. Alexander L. Howard traced the history of the forests, their denudation and afforestation work in Britain from the time of Henry II down to the present day. After reference to the disappearance of forests in other parts of the world and the resulting troubles caused thereby, Mr. Howard turned his attention to the afforestation work proceeding in Great Britain. What we want, he says, is the largest number of trees of both softwoods and hardwoods to be planted in the shortest possible time at the least possible cost. On the latter head there will be no disagreement; on the former, a certain section of opinion in Great Britain holds that, with the present high taxation, the whole of the burden of this afforestation work, the benefits of which can only be realised by future generations, should not fall upon the present one. After an analysis of the present position of the Forestry Commission and its expenditure, Mr. Howard advocates the formation of a regular Government Department "modelled on the lines of the best-known systems at present in existence". Mr. Howard—and many will agree with him—is insistent on the importance of increasing the areas of hardwood trees in Britain.

Plant Diseases in Egypt

THE Technical and Scientific Service of the Ministry of Agriculture for Egypt has recently issued a most valuable Bulletin on "Egyptian Plant Diseases: a Summary of Research and Control" (Bull. No. 146, Govt. Press, Bulâq, Cairo. Price P.T. 5. 1935). Mr. G. Howard Jones, director of the Ministry's Mycological Section, has written the text, which is a discussion of Egypt's position in relation to plant diseases, with a list of those which have occurred up to the present. Desert on three sides, and the sea on the fourth, render that country a somewhat isolated region, whilst the flooding of the Nile and the regularity of the seasons are further peculiarities. Rigid plant quarantine is one of the most effective methods of controlling fungus diseases in such an area. Research work has been directed to the investigation of individual diseases, the selection and testing of resistant host plants, the effects of differing level of the soil water table, and the progressive simplification of disease control. The last-mentioned question is of vital importance, not only in Egypt, but wherever busy farmers have to control disease in their crops. Seed disinfection with dusts is preferable to hot water treatment or to the use of liquid fungicides. The preparation of Bordeaux mixture is a very complicated process, so much simpler spray fluids are being developed. Eight reproductions of illustrated posters, with descriptions in the native language, are included in the Bulletin. One feels that Mr. Howard Jones and his colleagues really understand the situation in Egypt, and are doing their best to control the more serious diseases. The greater part of the publication is devoted to the list of diseases of crop plants, arranged according to their hosts, whose names appear in alphabetical order.

International Agriculture

"THE WORLD AGRICULTURAL SITUATION IN 1933-4", published by the International Institute of Agriculture, Rome (25 liras), forms the fifth of the series of "Economic Commentaries" on the "International Yearbook of Agricultural Statistics". The information is presented in a slightly different form from that in preceding volumes. The first part deals with world agriculture, its conditions and trends, and describes the market conditions of the chief agricultural products such as cereals, sugar, tea, coffee, wine, tobacco, textile materials and live-stock, while the second part is concerned with the agricultural policy and conditions in each of thirty different countries. A modification of the arrangement in the previous issues has been made and now information of every kind concerning each country has been grouped together in a single article. The development in Government intervention on behalf of agriculture has necessitated considerable extension of this part of the publication and has also led to the omission of the section devoted to the action taken by voluntary organisations, since this has inevitably become of increasingly smaller importance.

Shelterbelts and Windbreaks

IN Great Britain, shelterbelts are usually constructed as a protection against wind alone. In countries possessing arid areas of large expanse, like India and Mesopotamia, they are sometimes usefully employed against driven sand and dust. In these countries, the hot weather is usually accompanied by a daily wind rising with the sun and attaining its maximum about 1 p.m. and then gradually dying away. In some cases, the wind is so strong that it

carries small pebbles with it. It is not sufficient merely to plant grass to arrest the travelling sand dunes. The best way seems to be to plant suitable trees. In a paper by Dr. R. M. Gorrie published in the *Empire Forestry Journal* (14, 1; 1935) a scheme for enlarging farming shelterbelts so that they extend from the Canadian border down to Texas is described. Thousands of farmers have accepted aid from the Department of Agriculture, and the belts that have been constructed have greatly increased the comfort in which they live. In the arid Middle West, fruit growing becomes a possibility only when a shelterbelt is made. Dr. Gorrie says that the American scheme consists in multiplying the existing small windbreaks until about 2,500 square miles of forest has been planted. The layout of the belts is determined by the worst wind, and a width of about 150 feet is usually employed. As a means of relieving unemployment the scheme proved useful. In the same number of the *Journal* Mr. C. J. W. Pitt-Schenkel describes windbreaks in Tanganyika territory. A series of windbreaks are being planted across part of the country to check erosion and to protect the grass from being dried up rapidly by the prevailing wind.

Radium Deposits in North-West Canada

IN *Sands, Clays and Minerals* of June 1935, published by the Westmoor Laboratory, Chatteris, England, Dr. H. S. Spence, of the Canadian Department of Mines, gives an authoritative and well-illustrated account of the discovery, occurrence and exploitation of the pitchblende deposits found by Gilbert Labine in 1930 on the eastern shore of Great Bear Lake. Work to date has demonstrated the existence of extremely rich ore in three veins. Three months' operation of the Eldorado Company's mill showed that the raw material is of exceptionally high grade, the best being equivalent to a radium content of one gram per 6½ tons. Occurrences of native silver add to the value of the deposits, some of the ore assaying up to 9,000 oz. of silver per ton. In veins 1 and 3 and in part of vein 2 the pitchblende was originally deposited in botryoidal crusts which were later brecciated and re-cemented by quartz. In the other part of vein 2 the gangue material is not silica, but carbonates of manganese, iron and lime, together with barytes. It is this section of vein 2 which is characterised by native silver, in flakes and leaves occurring in both pitchblende and gangue.

OTHER discoveries of pitchblende have been made in this region; one immediately to the east of La Bine Point; another ten miles to the south-east; and another at Beaverlodge Lake, a hundred miles to the south. The last of these discoveries was made by smell! Indians had noticed a peculiar smell when camping at La Bine Point. In the winter of 1934 when the ground was covered with snow, they showed a prospector a spot on Beaverlodge Lake where they had noticed a similar smell. The snow was cleared and a pitchblende vein was disclosed beneath. An official town site has now been established at Cameron Bay, just south of La Bine Point. The Eldorado Company's radium refinery is at Port Hope, fifty miles east of Toronto, 4,000 miles from the mines. Up to June 1934, the plant had isolated 5½ grams of radium from 58 tons of pitchblende, together with 35,000 pounds of uranium compounds and 30,000 oz. of silver.

Reduction in Price of German Books and Periodicals

As a result of comments upon the excessive cost of German periodicals recently made in Great Britain and the United States, German publishers, two years ago, reduced their prices by 20 per cent. (See article by Dr. W. Bonser, Librarian of the University of Birmingham, NATURE of July 1, 1933, p. 34, and again of October 7, 1933, p. 540.) Unfortunately this reduction was at once counterbalanced by the fall in the value of the pound sterling. The German publishers are, however, making a further reduction, so that now the benefit will be appreciable. We are informed that: "From September 9th, 1935, there will be a discount of 25 per cent on the published prices of all new books originating from and published in Germany, on music and on all graphical instructive material, on subscriptions to periodicals, provided they were not charged before that date". The reductions will make a great difference to all university and society libraries; for example, the physiological *Berichte*, formerly costing 6 vols. at RM. 68 will now be at RM. 51—a saving of about £8 a year.

Recent Earthquakes

WE have received from Kew Observatory a notice of a violent earthquake recorded there at 14 h. 16 min. on September 11. The epicentre is estimated to have been in about lat. 43° N., long. 146° E., or about thirty miles off the south-east coast of the northern island of Hokkaido. This point is about thirty miles to the north of the epicentre of the destructive earthquake of April 25, 1843, after which seawaves 16 ft. high swept over the coast, and about eighty miles north-north-east of that of the less destructive earthquake of March 22, 1894, which was followed by seawaves about 5 ft. high on the coast of Hokkaido and 10 ft. high at Kamaisi on the east coast of Japan. A very violent earthquake was recorded at the Observatory at 2 h. 8 min. 13 sec. G.M.T., on September 20. The epicentre is estimated to have been 7,500 miles away, probably under the Pacific Ocean near the Mariamme Islands.

String-Figures

KATHLEEN HADDON (Mrs. O. H. T. Rishbeth), unquestionably our foremost expert in the study of the string-figure, has published a selection of these ingenious diversions for the use of beginners ("String Games for Beginners", Heffer and Sons, Cambridge. 6*d*. net). Twenty-four figures given here will serve as an introduction to their endless variety, and afford those previously uninstructed some idea of their wide distribution in various parts of the world. Mrs. Rishbeth has drawn on her own material collected in New Guinea and Australia, on figures brought back by Dr. A. C. Haddon from the Torres Straits, and

on material from various tribes of the Indians of North America. Instructions are reduced to their simplest terms, and a brief introduction sets out the significance of the string-figure, and explains why it is of interest to science as an indication of the life and thought of the people among whom each type of game occurs. Mrs. Rishbeth has considerately supplied a suitable piece of string which is attached to the book for the use of the reader.

Health of the Navy during 1933

THE health of the Navy during 1933 is detailed by the Medical Director-General, Surgeon Vice-Admiral R. W. B. Hall, in the Statistical Report of the Health of the Navy for the Year 1933 (London: H.M. Stationery Office. 2*s*. 6*d*. net). In a total force of 83,125, the number of cases of disease and injury was 41,852, a ratio of 503·48 per thousand, an increase of 40·53 in comparison with the five years' average and an increase of 31·80 in relation to 1932. The increase appears to be mainly due to an increase in the incidence of influenza and tonsillitis. Malaria, venereal diseases, tuberculosis and injuries, all show a decrease. The total number invalided also shows a decrease. Details are given respecting cases of interest and the pathological tests and surgical technique employed.

The Natural History Museum and Broadcasts to Schools

THE trustees of the British Museum have arranged for special talks and exhibits at the Natural History Museum in connexion with the biology course being broadcast to schools on Wednesdays, from September 25 until December 11, from 2.30 to 2.50 p.m. Within the limits of the accommodation, schools may attend at the Museum and listen to the broadcast talk in the board room, and immediately afterwards visit the appropriate specimens in the galleries under the guidance of the museum guide lecturer. For the benefit of schools which prefer to receive the broadcasts in their own classrooms, a special tour of the specimens by the guide lecturer will be available every Thursday at 2.30 p.m. For schools which may find it more convenient to attend at the museum only once or twice a term, more extensive tours may be arranged if particulars of what is required be addressed to the director. Arrangements also may be made with the director for schools unable to attend on Thursday afternoon to have the same lecture tour at some other time.

Announcements

THE ninety-fourth session of the School of the Pharmaceutical Society of Great Britain will begin on October 2, when Sir Frederick Gowland Hopkins will deliver the inaugural sessional address, at 3 p.m.

PROF. ALBERT SZENT-GYÖRGYI, who discovered vitamin C in capsicum, has succeeded Prof. Szeuky as director of the First Chemical Institute and professor of organic chemistry at Szeged.

THE twenty-fourth Congress of the Italian Society for the Advancement of Science will be held in Palermo on October 12–18 under the presidency of His Excellency the Honourable Di Marzio, rector of the University.

THE German General Medical Congress for Psychotherapy will be held at Breslau on October 3–6, when the subject for discussion will be psychical treatment in relation to psychiatry, internal medicine and education. Further information can be obtained from Dr. Hausdórfer, Psychiatrische Klinik, Breslau.

THE Fishery Institute of the University of Konigsberg, directed by Prof. Willen, has organised a vacation course from October 9 until October 16 at the sea fishery station at Neukuhren, Samland, consisting of lectures, practical work and excursions, to illustrate the hydrography and biology of the Baltic. Further information can be obtained from Fischerei Institut, Universitat, Konigsberg.

PARTICULARS of lectures, courses and classes arranged by the Warburg Institute and dealing with the survival of classical elements in European history of religion, social life, fine arts, science and literature have recently been issued. All lectures, courses and classes are open to the public, and admission is free. Further information can be obtained from the Secretary, Warburg Institute, 3 Thames House, Millbank, London, S.W.1.

THE sixth Turkish Medical Congress will be held at Angora at the end of October under the patronage of the President of the Turkish Republic and the presidency of General Ismet Inöniü, the president of Council and Prof. Refik Saydan, the Minister of Health and Social Assistance. The subjects for discussion will be rheumatism and alcoholism and drug addiction in Turkey. An exhibition of pharmaceutical products and medical instruments will be held during the Congress. Further information can be obtained from the general secretary, Prof. Fahrettin Kerim, 15 Boulevard D'Angora, Stamboul, Turkey.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A temporary demonstrator in botany in the University of Leeds—The Registrar (Sept. 30).

A lecturer in engineering in the Plymouth and Devonport Technical College—The Secretary for Education, Coburg Street, Plymouth (Oct. 5).

An assistant pomologist at the John Innes Horticultural Institution, 21 Mostyn Road, S.W.19—The Secretary (Oct. 7).

A chemical pathologist in the Department of Clinical Investigations and Research in the Manchester Royal Infirmary—The Director (Oct. 11).

A curator of the Zanzibar Museum—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (Oct. 15).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 517.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Dielectric Constant of Ionised Air

IN recent years, a large number of experiments have been carried out on the dielectric constant of ionised air with the object of verifying the Eccles-Larmor theory, which demands that the dielectric constant of an ionised gas should be less than unity. Study of the literature on the subject reveals, however, that most of the investigations are of a qualitative nature, and further that the experimental results obtained are often of an anomalous type, the recorded dielectric constant being frequently equal to, or greater than, instead of less than, unity.

The present note briefly describes and gives the results of an experimental investigation by which a quantitative agreement with the prediction of the theory is secured, and an insight is gained into the origin of the anomalous results by previous workers.

The principle of the experiment is the same as that employed for measuring the dielectric constant of a medium by the Lecher wire system. The air, contained in a glass tube (diameter 3 cm., length 75 cm.) and ionised by electric discharge, is placed between the Lecher wires, with the length of the tube parallel to the wires. The Lecher system is excited by an ultra-short wave valve oscillator. The wave-length in the ionised air is measured on the wires in the usual way by noting the positions of the bridge for resonance, and is compared with that measured in non-ionised air. Keeping the discharge current constant, the frequency f of the valve oscillator is varied and a series of wave-length measurements made. A graph plotted between K, the apparent value of the dielectric constant calculated from the change in wave-length, and $1/f^2$ gives a curve of the form ABC shown in Fig. 1.

Remembering that $K = 1 - 4\pi Ne^2/m(p^2 + \nu^2)$, conductivity of ionised air $g = Ne^2\nu/m(p^2 + \nu^2)$, and that resonance measurements give us wave-length of propagation $\lambda = 2\pi/\beta$, where β is wave-length constant (a function of g), e and m are electronic charge and mass respectively, ν is collisional frequency, $p = 2\pi f$ and N is electronic concentration, we can interpret the curve as follows.

From A to B the curve is nearly a straight line In this portion ν^2 is negligible compared with p^2, and λ is very nearly equal to $2\pi/p\sqrt{CL}$ since g is small (C and L being capacity and inductance per unit length of the Lecher wires). K therefore varies inversely as f^2.

From B onward the curve takes an upward turn. The dispersion here is apparently anomalous; K seems to increase with $1/f^2$. This anomaly is due to the fact that from B the value of ν^2 becomes comparable with p^2, and the effect on λ of the leakage between the wires due to conductivity of the ionised air begins to be appreciable. β has a tendency to increase and λ, as measured from the positions of resonance, decreases. K calculated from these values of λ decreases as $1/f^2$ increases.

In an actual experiment from the results of which the curve is drawn, the following values were obtained:

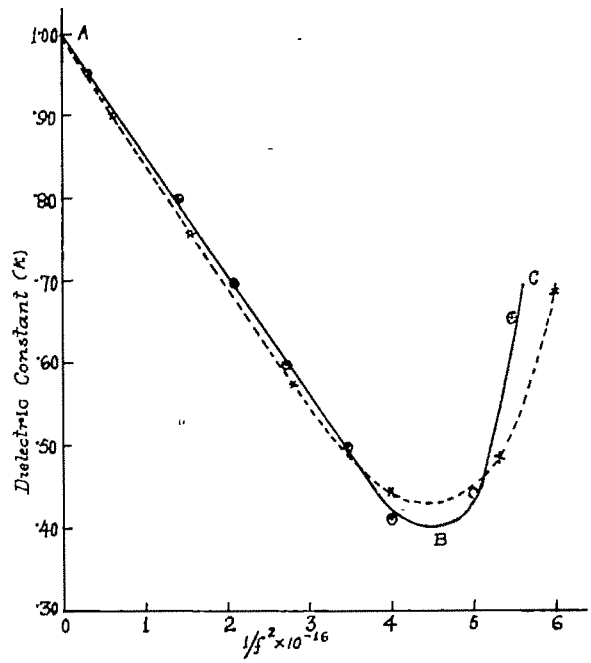

FIG 1. Variation of dielectric constant of ionised air with $1/f^2$, where f is the wave frequency.

$N = 1{\cdot}87 \times 10^7$ electrons per c.c. (calculated from observations when $p \gg \nu$; $\nu = 1{\cdot}15 \times 10^8$ (calculated from the temperature of the electrons and the pressure in the discharge tube; temperature determined experimentally by Langmuir's probe method); $f = 37{\cdot}9 \times 10^6$ to $4{\cdot}0 \times 10^8$. A curve plotted between apparent K and $1/f^2$ as calculated from these data is shown in dotted lines in Fig. 1. It will be seen that the agreement between the experimental and the theoretical curve is as good as may be expected.

The curves thus furnish on one hand a quantitative verification of the Eccles-Larmor theory of the decrease of the dielectric constant of ionised air below unity, and also explain how, due to the conductivity acquired by the air, an anomalous increase of the dielectric constant comes to be recorded.

It may be mentioned here that in the usual experimental procedure adopted hitherto, the object was to detect, in a more or less qualitative way, the sense of the change in the capacity of a parallel plate

condenser when the air between the plates contained in a glass tube is ionised by electric discharge. The parallel plates themselves are placed either inside or outside the discharge tube. Various explanations of the observed anomaly in these experiments have been proposed. These may be classified as: (*a*) existence of quasi-elastically bound electrons (Gutton), (*b*) formation of ionic sheaths on the condenser plates when these are placed inside the discharge (Appleton), and (*c*) conductivity (Pedersen, Appleton, etc.). The Gutton effect has been examined by Appleton and shown to be a distinct phenomenon not connected with the anomaly. Sheath formation has little or no effect, as is shown by the fact that curves similar to *ABC* have been obtained by us with the Lecher wires running inside the discharge tube. It therefore seems certain that the conductivity acquired by the ionised air is the true cause of the anomalous results obtained.

A detailed account of the investigation will shortly be published elsewhere.

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Photodissociation of Nitrous Oxide

THE action of light on nitrous oxide has been studied by several workers in recent years. It was found by Wulf and Melvin[1] that N_2O, when irradiated by light of λ 2350 A., broke up into NO and N. Later on, Dutta[2] studied the absorption spectrum, and found that light was continuously cut off from a long wave-length limit λ 2750 A., and showed that the energy equivalent of this wave-length accounts for the dissociation of N_2O into NO and N, both in the normal states. I extended this work[3] in the Schumann region, and two more continuous absorptions were found beginning from the long wave-length limits λ 1850 A. and λ 1580 A., separated by a region of transparency; it was shown that these further absorptions are responsible for raising N, one of the products of dissociation, to the metastable states ^2D and ^2P respectively. In short, the absorption of light by N_2O takes place in the following steps.

$$N_2O + h\nu_{2750} = NO\ (^2\Pi_{\text{normal}}) + N(^4S) \quad . . . (1)$$
$$N_2O + h\nu_{1850} = NO\ (^2\Pi_{\text{normal}}) + N(^2D) \quad . . . (2)$$
$$N_2O + h\nu_{1580} = NO\ (^2\Pi_{\text{normal}}) + N(^2P) \quad . . . (3)$$

The values of $h\nu_{2750}-h\nu_{1850}$ and $h\nu_{1850}-h\nu_{1580}$ could be compared with the values of $^4S - {}^2D$ and $^2D - {}^2P$ respectively obtained from the classification of atomic spectrum of N.

Recently, Henry[4] has remeasured the absorption spectrum of nitrous oxide at different temperatures and obtained the long wave limit of continuous absorption as λ 2140 ± 130 A. at absolute zero, by extrapolation. This value is quite different from that obtained by the earlier investigators. Henry assumed a process of dissociation like the following:

$$N_2O\ (^1\Sigma) + h\nu_{2140} = NO\ (^2\Pi) + N(^2D) \quad . . . (4)$$

This photochemical equation is claimed to explain not only the diamagnetism of N_2O (giving a $^1\Sigma$ state), but also the calculated value of the heat of dissociation of N_2, which is 6·9 ± 0·2 volts, is also found to agree with the latest value, 7·34 volts, given by Herzberg and Sponer[5]. It might be pointed out that opinions as regards the diamagnetic nature of N_2O differ, and at present there is no recent work to settle the point. There are several other points which may be put forward against the process (4) given by Henry.

The value $D_{N_2} = 6{\cdot}9 \pm 0{\cdot}2$ volts is decidedly lower than the present accepted value, 7·34 volts, given by Herzberg and Sponer. Herzberg and others have pointed out in several places that the energy of dissociation calculated from continuous absorption spectra always comes out higher than the true value. I have shown in a recent paper[6] that whenever there is a long tail of continuous absorption as in N_2O in the present case, the potential energy curve representing the interaction of the dissociated products will be very steep. Hence the absorption of light indicated by a vertical Franck-Condon transition from the ground-level will give a fairly high value of the heat of dissociation. The value of D_{N_2} calculated from such observations will be correspondingly higher than the true value, and not lower as obtained by Henry.

If the first long-wave limit of continuous absorption accounts for the dissociation of nitrous oxide into NO($^2\Pi$) and N(^2D) as indicated by (4), the two subsequent absorptions in the Schumann region beginning from λ 1850 A. and λ 1580 A. respectively, given by equations (2) and (3), will have to be interpreted in a different manner, probably in the following way only:

$$N_2O + h\nu_{1850} = NO\ (^2\Pi_{\text{normal}}) + N(^2P) \quad . . . (5)$$
$$N_2O + h\nu_{1580} = NO\ (^2\Pi_{\text{excited}}) + N(^4S) \quad . . . (6)$$

From (4) and (5) we get:

$$h\nu_{1850}-h\nu_{2140} = 0{\cdot}86 \text{ volts nearly}$$

and from (4) and (6):

$$h\nu_{1580}-h\nu_{2140} = 2{\cdot}06 \text{ volts nearly.}$$

These values are expected to give respectively the values of $^2D - {}^2P$ (= 1·19 volts) of N, and $^2\Pi_{\text{normal}} - {}^2\Pi_{\text{excited}}$ (= 5·61 volts) of NO approximately. The great lack of agreement here seems to throw doubt on Henry's suggestion regarding the photochemical dissociation of nitrous oxide in the quartz region. It cannot adequately account for the subsequent absorptions found by me in the Schumann region.

Further light is thrown on the problem from observations on the fluorescent spectrum of N_2O. I found[7] that when N_2O is irradiated by light having the short-wave limit at λ 1200 A., the β-bands of NO comes out in fluorescence. It was shown that in N_2O the production of the β-bands of NO can be accounted for in the following way only:

By absorption—

$$N_2O + h\nu_1 = NO(^2\Pi_{\text{normal}}) + N_{\text{normal}} \quad . . . (7)$$
$$N_2O + h\nu_2 = NO(^2\Pi_{\text{excited}}) + N_{\text{normal}} \quad . . . (8)$$

By fluorescence—

$$NO(^2\Pi_{\text{excited}}) \xrightarrow[\beta\text{-bands}]{} NO(^2\Pi_{\text{normal}}).$$

The excitation energy of the β-bands[8] is 128·8 k.cal., so that $h\nu_2 - h\nu_1 = 128{\cdot}8$ k.cal. If, according to Henry, $h\nu_1$ corresponds to λ 2140 A., we get $h\nu_2 = 262{\cdot}4$ k.cal corresponding nearly to λ 1090 A.

nearly. Consequently, light of wave-length greater than λ 1090 A. should not be able to excite the β-bands. Excitation can be brought about by λ 1200 A.; if $h\nu_1$ is taken to be in the neighbourhood of λ 2750 A. (Dutta), $h\nu_2$ comes out as near λ 1250 A.

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Electron Diffraction by Vitreous Silica Powder

I HAVE succeeded in showing recently that the comparatively coarse particles of any powder are suitable for structure investigation by means of electron diffraction[1]. For this purpose a mineral or other substance is ground carefully in a small mortar. The powder obtained is placed in a sedimentation air tube like that described by Gonell[2]. When blowing the slow jet of air through the heap of powder disposed at the bottom of this sedimentation tube, only the coarsest particles will return, while the minute ones will move with the air blast to the top of the tube where there is a big receiver. By placing there a suitable holder, for example, a loop of wire with a thin celluloid film for the transmission method, or a support for the reflection method, one can collect the particles, the sizes of which depend on the speed of the air blast. It is possible also to collect the smallest particles at the bottom of the tube. For this purpose it is necessary to blow the air for a few minutes only until the smoke appears at the top of the tube, and then to wait, in the case of a tube of one metre in length, in general about 10–15 minutes. Then all particles larger than 0·1–1·0 μ in size are precipitated at the bottom of the tube, the remaining being still suspended in the air. To collect the latter on the holder it is sufficient to wait in the case mentioned above about half an hour, after which the process had to be repeated a few times to accumulate a layer of sufficient thickness. It may be noted that the diffraction haloes from the celluloid film disappear completely only when the layer is thick enough. In this way I have obtained sometimes sufficiently clear diffraction patterns from specimens, which were otherwise quite unsuitable for electron diffraction, for example, ignited magnesia, sand, cements and tripolites. Mrs. L. I. Tatarinowa has proposed another method for preparing the specimens by drying on the celluloid film a drop of liquid with a fine suspension of the substance to be studied. This method, which gives sometimes excellent specimens for electron diffraction, has an especial advantage in that it requires only the minutest portion of substance. I have used successfully both these methods.

Here I will confine myself to the case of electron diffraction by vitreous silica glass, which does not give sharp rings when exposed to X-rays. It is of interest that such an amorphous body behaves like a true crystalline aggregate (see Fig. 1). On the best photographic plates, I have succeeded in measuring sometimes up to ten and even more distinct rings, which correspond approximately to the following Bragg spacings d:

Int.	*hkl*	(observed) *d*	(calculated) *d*
Weak	—	4 40	—
Very strong	111	4·03	4 04
Strong	002	3 64	3 64
Very strong	022	2 52	2·50
Weak	113	2 17	2·17
,,	222	1·99	2·02
,,	133	1·65	1·62
Fair	224	1·47	1 46
Weak	242	1·42	1·42
Fair	044	1·26	1·25
Very weak	026	1 11	1 14
,, ,,	046	1 01	0·99

(The first extra ring belongs presumably to an adsorbed organic substance from the vacuum grease.) Some of these rings, namely, the most intense ones, have been observed by L. R. Maxwell and V. M. Mosley[3] in their work on electron diffraction by transmission of electrons through thin films of silica glass. In spite of the lack of accuracy of the measurements, I am inclined to think that the above results can only be interpreted as a scattering by tetragonal cristobalite crystallites constituting the vitreous SiO_2. The axial ratio is 1·06; $a=6·87$; $c=7·28$. The size of these cristallites, which is probably of the order of 15–20 A., as estimated by J. T. Randall, H. P. Rooksby and B. S. Cooper[4] by measuring the breadth of X-ray diffraction band, is sufficient to give very sharp diffraction rings. The electron wave-lengths in my experiments were about 0·06 A., while these authors, as well as B. E. Warren[5], used an X-ray wave-length of 1·54 A., so that the sharp electron diffraction patterns with many lines are, of course, the consequence of greater resolving power of the electron rays. Hence the method of electron diffraction is applicable to a much larger range of substances than hitherto supposed.

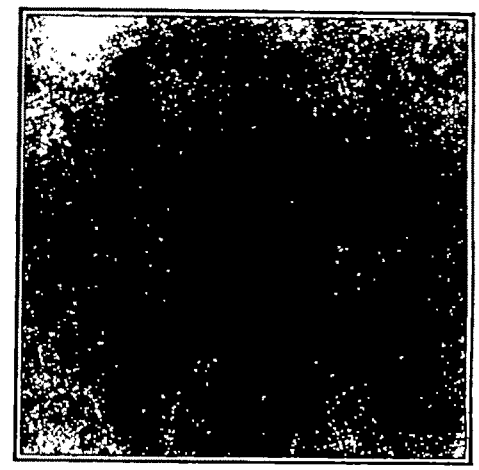

Fig. 1. Electron diffraction pattern of vitreous silica. × 2.

A fuller account is being published elsewhere.[6]

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Induced Radioactivity of Nickel and Cobalt

USING nickel as a receiving plate for the recoil of radio-elements produced in the Fermi effect I have found, contrary to the statements of Fermi and his co-workers[1], that this metal acquires a slight activity under neutron bombardment. This effect must be attributed to nickel, because it is exhibited by chemically pure nickel plates and nickel oxide. Further investigations have shown that the induced radioactivity of nickel is composed of two parts, one decaying with a period of about 20 minutes and another with a period of the order of a few hours. The activity of both products is very small: nickel plates of 0·1 mm. thickness exposed for 12 hours to the full neutron radiation of 40 millicuries of radon mixed with beryllium give an initial effect of 1·5 impulses per minute. The long-life activity is enhanced 4–5 times, when neutrons are allowed to pass through water; the short-period product shows no increase in this case. It is therefore probable that the first product is an isotope of nickel. The possible reactions leading to this product are:

$$_{28}Ni^{58} + {}_0n^1 = {}_{28}Ni^{59} \quad . \; . \; . \; (1)$$
$$\text{and } {}_{28}Ni^{62} + {}_0n^1 = {}_{28}Ni^{63} \quad . \; . \; . \; (2).$$

Reaction (2) is more probable since its end product would be the stable isotope 63 of copper. The small relative importance of Ni^{62} in nickel would account for the smallness of the effect observed.

As for the second product of about 20 min. period, I have been led, on the ground of some rules based on a survey of artificial radio-elements, to the following reaction:

$$_{28}Ni^{60} + {}_0n^1 = {}_{27}Co^{60} + {}_1H^1.$$

In order to test this assumption, I have irradiated cobalt in a large vessel containing water. In addition to the known radio-element Mn^{56} of about 2·5 hours period[1] I have found another activity which has a period of about 20 minutes and which does not appear when no hydrogen medium is used. The initial activity due to this product is of the order of 6 impulses per minute. The corresponding reaction must be:

$$_{27}Co^{59} + {}_0n^1 = {}_{27}Co^{60}.$$

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[1] E. Fermi, E. Amaldi, O D'Agostino, F. Rasetti, E Segrè, *Proc. Roy. Soc.*, A, 146, 483, 1934. 149, 522; 1935.

Spiral Orbits and the Law of Recession

FROM certain considerations of isotropy, one of us has obtained, in a paper communicated elsewhere for publication, the line-element

$$ds^2 = -e^{\mu}(dr^2 + r^2d\theta^2 + r^2\sin^2\theta d\varphi^2) + e^{\nu}dt^2, \quad . \quad (1)$$

where $\mu = \log(A + Bt + \frac{1}{2}t^2)$ and $\nu = 2 \log r$, A and B being arbitrary constants of integration. If $A = B = 0$, the geodesics give a straight line motion according to the law

$$\dot{r}/r = c/t, \quad . \quad . \quad . \quad . \quad (2)$$

where $c = -2$ or $\pm\sqrt{2}$. The two-dimensional motion is given by $\dot{r}/r = D/t$, and $\dot{\varphi} = \sqrt{(2-D^2)}/t$, . . (3)

so that $r d\varphi/dr = \sqrt{(2-D^2)}/D$, . . . (4)

which gives an equiangular spiral. If the spiral structure of the nebulæ is due to particles describing equiangular spirals as given by (4), and if the law of recession of the nebulæ themselves is of the form (2), then the line-element (1) seems to be of great interest in the relativistic theory of world-structure.

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Density of 100 per cent Heavy Water

THE density of D_2O was firstly estimated by Lewis and Macdonald[1] to be: $d_{25}^{25} = 1·1056$. Later Taylor and Selwood[2] found a higher number: $d_{25}^{25} = 1·1079$, and this figure has been used by several investigators. However, during the technical progress of concentration at the plant of the Norsk Hydro-Elektrisk Kvælstof A/S at Rjukan, indications were obtained that this figure was too high, and a number of careful pyknometer determinations of the density of 100 per cent D_2O in large quantities were, therefore, conducted.

The results obtained for the normal 100 per cent D_2O product (for which the density of the distilled electrolyte and that resulting from the combustion of hydrogen and oxygen from the cells were identical) were as follows:

$$d_{20}^{20} = 1·10711;\ 1·10712;\ 1·10713;\ 1·10714,$$

of which the highest figure ($d_{20}^{20} = 1·10714$) must be considered to be the nearest approach to the true value. The pyknometer determinations were correct to 0·000001. The value of the density obtained corresponds to $d_{25}^{25} = 1·1074$, that is, actually considerably lower than Taylor and Selwood's figure.

In order to determine the content of heavy oxygen in the water employed, 100 per cent D_2-gas was lead over hot copper oxide containing the normal O^{16}/O^{18}-ratio. The resulting water had a density: $d_{20}^{20} = 1·1070$, and consequently the isotopic ratio of the oxygen in the 100 per cent D_2O products does not differ appreciably from the ordinary ratio. Concentration of heavy oxygen during electrolysis of water is, however, actually found to take place under certain conditions[3,4], and the high figure of Taylor and Selwood for the density of heavy water may be due to a higher proportion of heavy oxygen in the samples employed.

On the other hand, the density of 'light water' with a D_2O-content less than 1 : 200000 has also been determined. d_{20}^{20} for this product was found to be $0·9999815 \pm 1\,\gamma$.

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Follicular (Œstrus) Hormone and Plant Tumours

A FEW years ago I observed that female rats and mice, given subcutaneous injections of a watery suspension of *B. tumefaciens*, or subcutaneous implantations of the crown gall tumours of pelargoniums, appeared to reach sexual maturity before control animals did. Harde[1], Yano[2], Dodds[3], and others, have given experimental proof of the possibility of a carcinogenic sensitisation of animals through administration of sexual—especially the follicular—hormones.

In previous experiments[1] it was clearly shown that the œstrus hormone had marked effects upon certain plants, and it was also observed that, when introduced in toxic doses through a petiolar stump into tomato plants, this hormone manifested its effects upwards along the stem, above the point of introduction.

In the present experiments, a similar introduction of an aqueous solution of a hormone was made into tomato plants, which were afterwards inoculated above and below the petiole with *B. tumefaciens*. Commercial crystalline œstrus hormones ('Glandubolin' of Richter, and 'Hogival' of Chinoin), prepared from urine of pregnant mares, were used; the average total dose absorbed was 434·3 mouse units per plant during the period June 8–21, 1935. In spite of the high dosage, toxic effects were almost negligible in comparison with those seen on tomato plants similarly treated in winter[4].

Thirty-one plants were treated with hormone, and a similar number served as controls; all were inoculated with *B. tumefaciens*, but twenty-one received distilled water, and ten received a deproteinised, hormone-free extract of animal tissue—in all cases via the petioles.

At the first sign of necrosis of the tumours they were cut off and weighed. The average weights of the tumours per plant were as follows:

Treatment	Position of tumours in relation to petiolar stump	
	Above	Below
Œstrus hormone	0 554 gm	0 303 gm.
Controls		
Distilled water	0 452 gm.	0·427 gm.
Special extract	0·407 gm.	0 423 gm

These results indicate that though the weights of the tumours on the control plants were not significantly a function of their position, the mean weight of the uppermost tumours on the plants treated with œstrus hormone was about 80 per cent greater than the mean weight of tumours below the petiole.

The final interpretation of these observations must depend upon further work to decide whether the direction of migration of the hormone in the plant is constant, or whether it is different with physiological and toxic doses.

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Effect of Vitamin C (Ascorbic Acid) on the Growth of Plants

THE effect of vitamin C on plants was studied with sterile plant cultures. 40 mgm. of crystalline ascorbic acid was added to the liquid medium. It was found that the dry weight of the treated plants was about 35–75 per cent higher than that of the controls. The differences were greatest during flowering. The treated plants also showed a much higher content of vitamin C, particularly at the early stages. These results are illustrated by the table below. It is pointed out that the observed increase of growth is specifically due to ascorbic acid, and not merely to an addition of organic material to the inorganic medium, since a similar addition of glucose effected no increase in the growth of the plants.

'Torstar'-peas in sterile Hiltner's solution ($Ca(NO_3)_2$); initial *p*H 5 5

Time of growth, in days	Stage of growth	Dry weight of 2 plants, in grams		Increase of crop per cent	Vitamin C per 1 gm dry matter (ml of indicator solution)	
		Treated	Controls		Treated	Controls
20	Before flowering	1 774	1 261	40 7	44	20
23	,, ,,	2 204	1 652	33 4	40	19
29	,, ,,	2·682	1 851	44 9	37	22
34	Start of flowering	4 641	2 666	74 1	35	24
39	Full bloom	5 692	3 835	48 4	36	30
44	Small pods	6·647	4·794	38·7	32	29
47	Full pods	7·119	4·343	63 9	25	26
50	,, ,,	7 906	5·550	42 5	24	25
52	,, ,,	8 122	5·820	39 6	23	24
55	,, ,,	8 423	6·117	37·7	21	24

Note added to proof. With regard to a communication by László Havas in NATURE of September 14, p. 435, concerning the effect of ascorbic acid on the growth of seedlings, I wish to point out that a report by me on the effect of vitamin C on plant growth[1] was published on May 8, 1935. Mr. László Havas has apparently not known of this earlier paper.

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[1] Synnove v. Hausen, *Suomen Kemistilehti* B, **5-6**; 1935.

Mycorrhizal Habit in the Genus *Citrus*

IN a communication to NATURE, written when visiting the Citrus Experimental Station, University of California, I directed attention to the mycorrhizal habit in species of *Citrus* used as stocks for orange in Southern California, and to the possible relation of this habit with observed inconsistencies of response to the application of nitrogenous fertilisers[1]. The matter is one of considerable practical interest in view of the prevalent use of such fertilisers and the heavy cost of manuring in Californian orchards.

An investigation followed, the recently published results[2] of which justify the views expressed in my original note. Intensive study of the cytological changes in the roots of plants from experimental plots receiving different manurial treatments leads the authors to emphasise "the importance of the mycorrhizal association as a factor in the metabolism of *Citrus* root cells", and to conclude that: "the relations between the root cell and the endophytic fungus contribute to an understanding of the responses

of the tree to nitrogenous fertilizers, and to the conditions favorable for infection by the endophyte".

Mycorrhizal structure as observed in *Citrus* under cultivation in California is similar to that found in the same species under natural conditions. The remarkably wide geographical distribution of this 'Phycomycete type' of mycorrhizal association, its prevalence in plant species of the most diverse affinities, together with its recorded appearance in certain crop plants, prompts me to urge once again the need for expert diagnosis of root condition in respect to mycorrhizal equipment as an index of soil environment favourable or the reverse, and as a guide to efficient manurial treatments of crops showing regular mycorrhizal associations.

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Electrical Conductivity of Copper Oxide Films Showing Interference Colours

THE measurement of the electrical resistance of films of copper oxide on copper showing interference colours of the first order has given results varying from 0·002 to 15 ohms per sq. cm. at 25° C. On massive copper surfaces the temperature coefficient of the resistance is positive and somewhat less than that of metallic copper, while the resistance measured is very small, lending support to the view that the very fine structure of the film is very heterogeneous and minute areas of metal are probably exposed. These areas are too small for the microscope and spectrophotometer to show their presence.

With activated surfaces the electrical resistance is very much higher, and the temperature coefficient is negative, like that of the oxide. Although the surface colour showed striking homogeneity in many cases, shearing and breaking the metal showed a considerable thickness (up to 10^{-3} cm.) of activated film and graded colour sequences through the fracture corresponding to thinner films on the granules as the distance from the surface increased.

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Points from Foregoing Letters

THE variation of the dielectric constant of ionised air with wave frequency has been determined by Prof. S. K. Mitra and S. S. Banerjee. Their findings verify the Eccles-Larmor theory, which demands that the dielectric constant of an ionised gas should be less than unity, and shows that owing to the conductivity acquired by the ionised air, an anomalous increase of the dielectric constant is recorded.

Prof. P. K. Sen-Gupta adduces several arguments to substantiate his claim that nitrous oxide gas, N_2O, is broken down into NO and N by ultra-violet light of wave-lengths 2750, 1850 and 1580 A. (in which regions nitrous oxide has absorption bands), and not by wave-length 2140, at absolute zero, as claimed by Henry.

A photograph indicating the electron diffraction pattern obtained with powdered vitreous silica is submitted by N. A. Shishacow. Unlike the photographs obtained with the same material with X-ray of wave-lengths 1·54 A., the photograph obtained with electrons, the energy of which corresponds to a wave-length of 0·06 A., and have a correspondingly greater resolving power, shows distinct rings, indicating the presence of tetragonal cristobalite crystallites constituting the vitreous silica.

By bombarding nickel with neutrons from a powerful radon-beryllium source, J. Rotblat has succeeded in producing radioactivity of two life periods, of twenty minutes and two hours respectively. He ascribes the longer-lived product to the formation of an unstable nickel isotope of mass 59 or 63, and the shorter radioactivity to radioactive cobalt of mass 60, formed from nickel-like atoms of the same mass. Mr. Rotblat has further obtained the radioactive cobalt of the same life-period by bombarding cobalt of mass 59 with neutrons.

Dr. V. V. Narlikar and K. V. Sastry direct attention to a new formula for a line-element, which may prove of great interest in the relativity theory of world-structure.

New measurements of the density of heavy water, by Dr. L. Tronstad, J. Nordhagen and J. Brun, give 1·10714 as the nearest approach to the correct value at 20°C. The authors suggest that the higher value obtained by Taylor and Selwood may be due to a higher proportion of heavy oxygen in the samples employed. The density of the purest light water (free from the heavier variety) was found to be 0·9999815.

Bacillus tumefaciens injected into the stems of tomato plants produces characteristic tumours of a given average size. László Havas, by injecting aqueous solutions of sex hormones, finds that the average size of the plant tumours above the site of the injection increased, while those below the site of injection decreased. Further work is necessary before it can be determined whether the direction of migration of the hormone is constant, and whether it varies with physiological and toxic doses.

Vitamin C, added to sterile plant cultures, leads to an increase of 35–75 per cent in the dry weight of the plants, according to experiments reported by Dr. Synnove v. Hausen. This increase is due to ascorbic acid specifically, and not merely to the addition of an organic substance, since controls using glucose produced no such increase. The greatest differences were obtained during flowering.

Recent publications by Prof. H. Reed and Mlle. Frémont from the Citrus Experimental Station, University of California, confirm views expressed in NATURE by Dr. M. C. Rayner respecting the practical significance of the mycorrhizal habit in *Citrus* cultivation. The necessity for expert diagnosis in other crop plants showing similar root relationships is urged.

Research Items

Geological Age of the Markleeberg Palæolithic Industry

THE distinctive palæolithic industry found in the gravels of Markleeberg on the right bank of the Pleisse, approximately 8 km. south of Leipzig, of which examples were first collected in 1895, and of which accounts have appeared on numerous occasions since 1911, has given rise to much controversy owing to an apparent contradiction between its position in the geological time-scale and its relation to the culture sequence of the French archæological classification. On typological grounds, the industry is regarded as a Mousterian which retains certain primitive characters in its technique and shows Acheulean influences. In a discussion of the geological evidence of the age of the deposits in which the industry appears M. R. Grahmann points out (*L'Anthropologie*, **45**, 3–4) that difficulty arises, to a great extent, from the fact that the quaternary geology of the area is only very imperfectly known. Recent research has shown that there is evidence of three glaciations, corresponding to those of northern Germany, which may be termed Elster, Saale and Vistula. Applying this scheme to the Markleeberg deposits, the evidence is interpreted as indicating the moraine of the second glaciation, the Saale, as the source of the industry. Probabilities, however, point to the industry being older, while the diversity of facies it exhibits may well be due to the moraine having gathered up the debris of a number of sites of different ages. A suggested correlation of this scheme with that of the Alpine and north European glaciations equates the Markleeberg industry with the beginning of the Riss glaciation and makes it contemporary with the French Acheulean, thus indicating a difference in the course of development of stone age industries in central and eastern Europe and the west, while tending to support the view that the former were the earlier.

Agricultural Ceremonies in the Naga Hills

IN a communication dealing with the effect of ritual upon industries and arts in the Naga Hills, Mr. J. P. Mills (*Man*, **144**, September) describes the agricultural ceremonies observed by the Nagas during the year, which have not previously been recorded. The village is a closely knit community which acts together in seeking the favour of the spirits for the crops of all. The essential act of worship is a day of rest, on which no one is allowed to work in the fields. In all, there are about seventy *kennü* days in the year; but they are so arranged as not to interfere with agricultural operations. Thus in those months when the people are busily engaged in clearing the ground, sowing the millet or preparing for the growing of the important rice crop, few *kennü* days are observed, except here and there for rest from the work in hand. The close of a time for a particular operation, such as, for example, of the season of pot-making in January, is marked by a day of rest. Private ceremonies, from the nature of the case, do not show the same consideration for agricultural operations, and the observance of the days of abstention, such as are enjoined for sickness, a birth or death, make serious demands on time which may extend to as much as five days at a time. The agricultural year opens in January with three days of purification, after which the clearing of new *jhums* and the sowing of millet begins. In March, when it is time to think of the rice, four days between March 10 and 15 are days of *kennü* and feasting preparatory to beginning the main work of the year. At various dates in the following months there are *kennüs* to avert bad luck or damage from various causes, such as hail, grubs, ants, etc. Jungle clearing is accompanied by a great deal of feasting and jollification. *Kennüs* take place on September 10 and 11 for the solemn eating of the first fruits, and on November 24–December 5 the whole village gives itself up to the great feast which marks the end of the year's work.

Cobalt and 'Coast Disease' of Sheep in Australia

As is well known, minute amounts of certain elements, for example, copper, manganese, zinc, boron and others, are necessary for the normal nutrition of animals and plants, and evidence has been obtained that 'coast disease' of sheep in South Australia may be due to a deficiency of cobalt (Marston and Lines, *J. Council for Sci. and Indust. Res.*, Commonwealth of Australia, **8**, No. 2, pp. 111–117). In this disease, sheep fed on certain pastures become lethargic and anæmic, waste and ultimately die. The soil in the area is deficient in certain elements, notably phosphorus, but additions of iron, manganese, arsenic, copper and phosphates failed to cure or prevent the disease. Other elements were also eliminated, and as cobalt had been found experimentally to increase the number of blood-corpuscles, it was decided to test the effect of this element. Two sheep which were almost *in extremis* with coast disease were therefore given 1 mgm. a day of cobalt in the form of cobaltous nitrate. The effect was almost immediate; within three days the animals improved in health, appetite and body weight, and in the condition of the blood, and within ten weeks had become almost normal again.

Mollusca of Lake Geneva

AN interesting study of the ancient and modern molluscan fauna of Lake Geneva is made by M. Jules Favre ("Études sur la Partie Occidentale du Lac de Genève. 2. Histoire Malacologique du Lac de Genève". *Mem. Soc. Phys. et d'Hist. Nat. Genève*, **41**, Fasc. 3, 1935). Many species are discussed, but of special importance is the variability of *Valvata piscinalis*, which is very different at different depths. Two forms are found now living in the lake, the form *antiqua* having a thick and opaque shell, greyish yellow, pale, turriculated, with scarcely any umbilicus, which is distributed almost everywhere on the muddy bottom of the littoral and sub-littoral zone down to about 25 metres, then becoming scarce and disappearing at 40 metres, and the form *alpestris minor* having a whitish shell, diaphanous or almost hyaline with conspicuous transverse striations and large umbilicus, a much smaller form than *antiqua*. The form *alpestris minor* is now rare in the lake and localised in the vicinity of certain fields of Characeæ in the Bay of Belotte between 5·50 and 10 metres. It represents the primitive form occurring in the post-glacial sediment which has given rise to the common form *antiqua*, the latter being the best adapted to

littoral regions, thriving in the sub-littoral zone where it is not battered by the waves and tending in the littoral regions to be the typical form of *V. piscinalis*. The species established itself in the lake in Post-Glacial times very soon after the retreat of the glaciers, and was among the first of the molluscs to invade the sub-littoral region, rapidly undergoing important developments and varying greatly when large masses of Characeæ filled a certain part of the area, these algæ having a profound influence on the species. Then the original form varied in different ways according to its habitat, those on the muddy bottoms after much variation giving rise to the turreted *antiqua* with constricted umbilicus, now the commonest form to be found in the lake, those in the *Chara* beds being mainly planorbis-like flattened forms with large umbilicus. The form *alpestris minor* recalls the ancient population, and is only to be found in the fields of Characeæ.

Australian Cowries

COWRIE shells, popular with amateur collectors because of the beauty of their texture and patterns, have been well illustrated in colour in well-known monographs by the earlier workers. The difficulty of observing the living inhabitant, on account of the readiness with which it withdraws into its shell, has for the first time been overcome on a large scale by the Australian naturalist, Melbourne Ward. He has observed and made paintings of twenty species which he kept alive in his aquarium, and the paintings have served to differentiate species which on shell-characters alone seemed to be indistinguishable. Coloured figures of the living animals and their shells, with adequate descriptions, have been published in a complete list of Australian cowries (Cypræoidea) by Tom Iredale (*Australian Zoologist*, 8, 96; 1935); and the animals are even more beautifully coloured than their shells.

Development of May-Flies

IT has long been known that certain species of Ephemeroptera, or may-flies, pass through a very large number of nymphal instars. In this respect, they only find their parallel, in other insects, among the Plecoptera or stone-flies. An account of the post-embryonic development of several species of may-flies by Mr. F. P. Ide has recently appeared (*Canad. J. Res.*, 12, 433, April 1935). The life-histories of *Stenonema canadense* and of *Ephemera simulans* are described in detail, and those of nine other species less completely. In *S. canadense* the number of ecdyses was found to be between 40 and 45 and in *E. similans* about 30. At each moult there is some increase in size, but the significance of moulting seems to be primarily for the purpose of changing morphological structure. Every change in external structure, even to the addition of a single seta, can only be accomplished through ecdysis. The determination of the instars is stated to be possible owing to the fact that each moult results in a change in the number of segments in the caudal filaments. The author comments upon the fact that many other insects grow to a much greater size than may-flies and yet only pass through four or five moults. He concludes that it is unlikely that so many moults could be concerned primarily with increase in size and that the reason seems to be in the need for the nymph to be constantly changing its structure in order to adjust itself to environmental changes.

Intertidal Ecology

THE study of the habits and distribution of the animals and plants inhabiting the intertidal region of the shore is one of considerable difficulty on account of the complexity of the environmental factors involved. Where many factors such as wave-exposure, emersion and immersion, insolation, etc., are concerned, it is desirable to study localities with as simple conditions as possible. Kitching (*Trans. Roy. Soc. Edin.*, 58, Pt. 2, No. 15, 1935), in describing a number of places on the Argyll coasts, has related the size and abundance of some of the most important species of animals and algæ to wave-exposure, level and angle of slope of the rock. He also gives some data with regard to the hydrogen ion concentration, oxygen content and temperature in the various places. While some of the relationships are comparatively simple, such as the limiting wave-exposure which some algæ can stand without being detached, or the inability of barnacles to survive within the 'sweep' of the larger brown algæ, many of the relationships are very much less obvious, and collection of many more observations of this nature will be necessary for their elucidation.

A Rare Carnivorous Plant

DR. JOJI ASHIDA has given a very full account (*Mem. Coll. Sci., Kyoto Imp. Univ.*, B, 9, No. 3, Art. 5; 1934) of the opening and closing mechanism of the leaf blade of *Aldrovanda vesiculosa*, L., an animal-catching mechanism which has very seldom been studied, and never so thoroughly. Dr. Ashida was successful in growing this plant in culture throughout the year, the presence of dead leaves and stems of certain other aquatic plants proving to be the special requirement of this plant. The motile zone of the leaf blade lies at a distance of 0·15–0·25 mm. from the midrib and works apparently as the result of a loss of turgor of the inner epidermal cells on stimulation. The outer two layers, still turgid, then bend the two lobes so as to shut the leaf. After shutting, the surfaces are still compressed closer together, narrowing the cavity which encloses the animal victim. This is due to an increase of turgor and an active elongation of the outer epidermal cells; the water needed for the movement enters mainly through the outer surface. The subsequent expansion of the cavity within the closed leaf lamina and opening of the leaf is attributed to a transverse growth of the inner epidermis.

Distribution of Earthquakes in New Zealand

THE seismic record of New Zealand begins in 1848, and, from that time until the end of 1934, more than 6,000 earthquakes have been reported from various parts of the country. The distribution of these earthquakes, as regards both frequency and intensity, has recently been studied by Messrs. L. Bastings and R. C. Hayes (*Wellington Dom. Obs. Bull.*, No. 95; 1935). They divide the whole country into 19 areas roughly equal in size by lines of latitude and longitude. In the frequency map, the areas are shaded in tints depending on the percentage of the total number of New Zealand earthquakes felt within them. The highest percentage, 26·0, is reached in the district visited by the Murchison earthquake of 1929. A percentage only slightly less, 25·6, marks the western half of the central portion of the North Island, but this is due to the occurrence of more than a thousand

local shocks in and near Taupo in 1922. The district including Hawke's Bay has a percentage of only 9·0. The second map represents the maximum intensity of the earthquakes in the different areas, in six of which, at the north end of the South Island and the southern portion of the North Island, the tenth or highest degree of the Rossi-Forel scale was attained.

Theory of Elastic Solids in Practice

THE problems that arise when applying mathematical analysis to the stresses and strains in elastic solids only admit of exact solution in a few special cases. The demand for more accurate solutions has recently become urgent in the design of large electrical machines, as, owing to the improved methods of cooling now adopted, the permissible output has been greatly increased, and consequently the determination of the stresses and strains has become of primary importance. In the *Journal of the Institution of Electrical Engineers* of August, R. Poole discusses the various forces—magnetic, gravitational and mechanical—which act on the frames of large machines. It is pointed out that the effect of the magnetic pull on the frames is of great importance. He gives a method of analysis for calculating these effects which will be useful in practice, since it provides a means of showing the safe wear on the bearings of a machine and thus fixes the limits of mechanical design. As a check upon certain of the assumptions made in the mathematical treatment of the problem the author carried out photo-elastic tests upon model frames made of celluloid. The coloured photographs shown enable the distribution of the stresses and their approximate magnitudes to be seen at a glance. It is interesting to remember that these photo-elastic methods are based on the discovery made by Sir David Brewster that when a piece of glass is stressed and viewed in polarised light under certain conditions, brilliant colour effects are produced owing to the glass becoming double refracting. Prof. E. C. Coker has recently perfected an apparatus for this method of testing.

Stress and Elasticity

AMONG the papers issued by the Institution of Mechanical Engineers for written discussion (to reach the secretary before October 31) are three which are of general interest to physicists. In one of these, Dr. W. A. Scoble, the reporter, presents the fifth and final report of the Wire Ropes Research Committee, which, besides dealing with further series of tests made on ropes of different construction subjected to various degrees of loading, bending, lubrication, etc., contains an appendix reviewing the work of the Committee. This brief statement authoritatively corrects several misconceptions, particularly regarding the true factor of safety, and provides a guide as to the best conditions under which to employ wire ropes. In "Stress Waves in the Tyres of Locomotives", Prof. E. G. Coker and Dr. M. Salvadori exhibit and explain a photo-elastic investigation of the stress wave travelling in a locomotive tyre. The effects of the rail, the chairs, the spokes and the balance weight are shown in a series of diagrams. Dr. David Robertson presents a paper, "Hysteretic Influences on the Whirling of Rotors", in which are summarised the known facts concerning elastic hysteresis. It is shown that this can produce whirling when the shaft is running above its critical speed, and that the action of clamping fits, couplings and endwise friction may tend to produce similar effects. An approximate quantitative theory is evolved.

Steam Turbines

UNDER this title, the Association of Engineering and Shipbuilding Draughtsmen has issued a paper by C. S. Bradshaw (London: The Draughtsman Publishing Co., Ltd.). The series of printed pamphlets, to which it is the latest addition, consists of papers written by practical men for the use of others engaged on similar work, and the present issue is in full keeping with this tradition. The author is concerned at each stage of his examination of the subject with making typical calculations for the guidance of his reader. After treating in detail the several principles involved in the utilisation of steam in an engine of this kind, he proceeds with the preparation of the provisional design for a 3,000 k.w. impulse turbine to the extent of determining the steam consumption, efficiency and details of nozzles and blades. The author also explains the advantages of extraction turbines as developed to meet the case where, in addition to power, a supply of low-pressure steam is required for heating or industrial purposes, showing that in a particular case a saving of nearly 25 per cent in fuel may be effected. As to future design, his view is that a primary turbine will operate in the range from 3,000 to 600 pounds per square inch, the steam then passing to the main turbines, an arrangement which he considers would raise the overall station efficiency from the present figure of 26 per cent to one of 35 per cent.

Furfural Yield of Uronic Acids

THE separation of hemicelluloses from other plant constituents is a matter of some difficulty, and no satisfactory criteria of purity or homogeneity exist. Plant gums, which are also polyuronide in nature, have similarly been found to be complex mixtures without any sharply defined differences of properties. It has, however, been customary to determine the relative amounts of the major constituent groups in such preparations. By determining the evolution of carbon dioxide on distillation with 12 per cent hydrochloric acid an accurate figure for the uronic acid content is obtainable. Furfural determinations similarly give an estimate of the pentose content. Because it is known that uronic acids also yield some furfural under the conditions of that determination, a correction has been applied by many workers, based on an assumption that the yield of furfural from a uronic acid is $\frac{1}{8}$. Norris and Resch at Birmingham have critically examined this point (F. W. Norris and C. E. Resch, *Biochem. J.*, 29, No. 7, 1590; 1935) and find this assumption to be incorrect, the true value being considerably higher, and moreover influenced appreciably by the presence of other units such as hexoses. The significance of their observations will be realised when it is stated that the commonly accepted formula for pectin depends on a calculation employing the earlier erroneous factor. The conclusions of many other researches on the composition of hemicelluloses, mucilages and gums may have to be revised for the same reason. The effect of the use of the lower factor has been to cause the pentose content to be over-estimated and the hexose content under-estimated. This is more serious in the case of pectin and certain gums of high uronic content than in the plant hemicelluloses, the uronic content of which is much lower.

Fire-walking

AT the suggestion of the secretary of the Institute of Physics, I attended the demonstrations of fire-walking by the Indian, Kuda Bux, on September 9 and 17. Notes on some physiological aspects of the second demonstration were published in NATURE of September 21, p. 468. One important detail should, however, be added, the time of contact of the performer's feet with the fire, which was certainly much less than five seconds.

Observations made at the first performance indicated that the feat was merely another form of the fireside experiment of picking up a hot cinder and returning it to the fire, when the fingers are not burnt, if the action is performed quickly. It, therefore, seemed probable that measurements of the rise in temperature caused by contacts of a cold substance with the fire, of similar duration to those of the walker's feet, would test the correctness of this view, and preparations were made to do this at the second trial on September 17. On this occasion, Dr. T. E. Banks, of the Physics Department, St. Bartholomew's Hospital, and Mr. G. Smith, of the London School of Hygiene and Tropical Medicine, collaborated with me in making the observations.

These comprised the measurement of the total time of contact of each foot with the hot surface; counting the number of steps; and then pressing a thermal junction on to the fire intermittently so as to imitate the period of contact of each foot and the interval between each step, the rise in temperature then being noted on the indicator. The junction consisted of a thin disc of copper, to which wires of copper and eureka were fastened. The wires were passed through holes in a piece of uralite and pulled, so as to bring the disc into contact with the uralite, so that when the disc was pressed on the fire the conditions were favourable for the absorption of heat and its retention when the junction was raised for another impact.

The arrangement was equivalent to a sensitive walking thermometer, and would certainly show a greater rise in temperature under the same conditions than the human skin, which is protected by the moisture it exudes.

Careful observation with a stop-watch having shown that the average time of contact of the walker's foot was half a second at each step, and it being noted that each foot rested twice on the surface during the passage, the junction was struck on to the surface twice in succession, a period of contact of half a second per impact being attempted. Actually, owing to the difficulty of working near the fire, this period was always exceeded, but a number of separate trials showed a rise of 15°–20°C. in the junction. This was conclusive evidence that the feet of the performer would not become hot enough for blistering to occur.

Fire-walking is really a gymnastic feat, and the agile way in which Kuda Bux walked across the fire compelled admiration, and would be difficult to imitate without much training. It would not be easy for a beginner to walk bare-footed over cold charcoal so as not to exceed the time of contact necessary for successful fire-walking. It was lack of training in this particular which prevented Mr. Moynagh and Mr. Sheepen from succeeding; but it was noticeable that even in their cases large portions of the feet were uninjured. Both were much heavier men than Kuda Bux, and this caused them to sink more deeply into the fire, and increased the time of contact. A temperature-measuring device conforming more nearly to the conditions of the skin could be made and tested on a fire, but the explanation of fire-walking is so obvious that this would be superfluous.

CHAS. R. DARLING.

Work of the Rothamsted Experimental Station

AN event of great importance in the history of the Rothamsted Experimental Station occurred in 1934, namely, the purchase of the farm and adjoining lands by the Rothamsted Trustees. Few people perhaps realise that hitherto this experimental centre, with its long-term trials known the world over, was held only on a lease, and that it was threatened by the encroachment of the builder. The sum necessary for purchase was speedily raised by public subscription. A glance at the subscription list gives ample testimony, if such were needed, of the high esteem in which the Station is held by farming organisations and business men It is not out of place perhaps to mention here that unique organisation—the Society for Extending the Rothamsted Experiments—which was founded in 1904. This Society has not only helped financially, but, by looking ahead, has also enabled important work to be initiated without the delays that usually occur if the money question is left until it is time to start work. Among the many old and modern documents in the Station library, the minutes of this Society will be among the most interesting in years to come.

The report for 1934* opens with an account of the continuation of the experiments on yield and quality in sugar-beet, potatoes, wheat and barley. In the sugar-beet work it is pointed out that most of the information available on this crop applies to Continental conditions, and that it by no means follows that recommendations suitable abroad are applicable in Great Britain. Thus, in these trials, potash and phosphate appear to have but little effect, a result that would scarcely be expected from the data that are available on this crop.

The work on organic manures continues, and shows

* Rothamsted Experimental Station: Lawes Agricultural Trust Report for 1934. Pp. 259. (Harpenden: Rothamsted Experimental Station, 1935.) 2s. 6d.

that there is a considerable amount to be learnt about green manuring; the investigators, however, appear to be nearer to explaining the negative results, noted in the 1933 report, obtained by the use of green manures on the light soils of Woburn. The trials with poultry manure, commenced in 1933, have been continued with market garden crops, the manure having been compared with equivalent mixtures of sulphate of ammonia and superphosphate; the nitrogen in the dried poultry manure did not prove so valuable as the nitrogen of sulphate of ammonia.

A valuable feature of the report is provided by articles on the contribution of the various departments to the study of soils and crops. Thus, work on soil physics is reported on by Dr. B. A. Keen, and that on the chemistry of soils and fertilisers by Dr. E. M. Crowther; the contribution to soil bacteriology is discussed by Dr. H. G. Thornton, and that on general microbiology by Mr. D. W. Cutler. In the Soil Physics Department, much attention has been given to the study of the plastic behaviour of soil and clay, work which is of interest to the ceramic industry as well as to the cultivator of the soil. Among the results of theoretical interest may be mentioned the grave doubts thrown on the reality of 'structure turbulence' and 'structure viscosity' in soil and clay pastes—subjects that have been extensively studied by other workers. In practical soil cultivation, the work touches aspects such as ploughing speed, and tilth. In the section dealing with soil cultivation, great importance must be attached to the studies on the effects of rotary cultivation. This method of tilth production is entirely new, and of great promise; the work at Rothamsted will give advisers and investigators definite information upon which to work. In Dr. Crowther's contribution, special interest is attached to the hypothesis which is put forward that, in a heavy soil, nitrate washed out of the surface may be stored in the structural units of the subsoil. To quote this report, "it seems possible that this hypothesis may serve to bridge the gulf between the pedologist's concern with the deeper horizons and the analyst's use of surface samples".

The Manager's report on the Rothamsted and Woburn farms, together with the notes on the weather, and on the insect and fungoid pests could not fail to interest any farmer. Indeed, the Rothamsted annual reports, in addition to their value to the agricultural scientific worker, can be recommended as deserving a place on the bookshelf of all intelligent farmers.

American Universities and Game-Rearing

THE American universities have been conspicuous in their pioneer additions of practical subjects to the university curriculum, and it is particularly interesting, therefore, that, as J. N. Darling, Chief of the Bureau of Biological Survey, U.S. Department of Agriculture, describes in a paper in the September issue of *Scientific American*, 30,000 dollars for an endowment fund for five years has been offered by an anonymous U.S. arms' manufacturer to the Biological Survey for wild-life restoration and administration training at several of the State universities. It has been announced that several State universities are to set up courses in game management with the active support of the Bureau of Biological Survey, which will supply instructors and contribute 42,000 dollars; State and game conservation organisations will also combine in the scheme, and original research in wild-life subjects will be incorporated in the training course, as is done with the forestry training.

"The reservation of enough grazing lands to maintain a reasonable supply of our big game animals can be accomplished without infringing upon the reasonable requirements of the stock growers", Mr. Darling states. "The same is true of small game species. A few large reservations of the hereditary ranges, supplemented by development for wild-life purposes of waste lands, of odds and ends such as ravines, sloughs, roadside strips, fence rows and sub-marginal tracts will be sufficient to bring back wild creatures even in our intensively cultivated areas in more abundance than has been observed for two generations. . . . On most land midway between fertility and barrenness, fish, game and furbearers can exist with far better profit to humanity than when given over to a desperate sort of agriculture. Throughout the U.S. the total drained areas equal 110,000,000 acres."

Wild-life and game animals, and especially non-migratory birds, have decreased markedly in the United States during this century, owing to extensive shooting with little organised game protection or conservation. Ten years ago, Maine alone produced more mink pelts than are now annually produced in all the United States. The trumpeter swan is confined to a few haunts, of which Yellowstone National Park is one. With State and Federal aid, a herd of 20,000 elk still exists in the Jackson Hole region of Wyoming. Within recent years the "More Game Birds in America" Foundation was formed and incorporated in New York to increase American game by the control of their natural enemies and the following of intensive game-rearing on lines similar to those adopted in Europe, particularly Great Britain, where since the passing of the Game Act of 1831, partridge have increased more than 200 per cent and pheasants more than 1,000 per cent, and in the six years 1919–25, after War-time diminution, British gamekeepers increased the nation's stock of game-birds by 900 per cent.

In 1934, Prof. A. A. Allen, of the chair of ornithology at Cornell University, succeeded in rearing ptarmigan in captivity for the first time, hatching eggs obtained in the Hudson Bay region, under bantams. The Bureau of Biological Survey already possesses divisions studying water-fowl numbers, game conservation, predatory animal and rodent control, fur resources, with considerable numbers of reserves and stations, and there is an Alaska Game Commission. Bag limits are made to protect wild geese and other birds in many States, and methods of hunting and shooting are under legal control in many States.

E. H.

Royal Photographic Society

ANNUAL EXHIBITION

TO the man in the street the results of photography are 'pictures' of one sort or another, but mainly intended to be artistic. The eightieth Annual International Exhibition of the Royal Photographic Society usually emphasises in the mind of the visitor this artistic aspect of photography; in the principal gallery, for example, are one hundred and seventy large prints, all of pictorial character, whilst in another room are more than two hundred pictorial lantern slides. Photography is, however, both a science in itself and a good servant to most other sciences. This exhibition gives a suggestion of its varied problems and applications.

This year, the Eastman Pola light filters seem to be the outstanding example in the exhibition of a photographic problem solved. These filters incorporate a plane polarising material and can be manufactured in sizes large enough to cover camera lenses, and even light sources. They can be used to eliminate the glare, due to surface reflection, from all sorts of objects. Some excellent examples of this are shown, notably some photographs of polished carving and of an oil painting. In the latter, reflections from the brush-marked surface are completely eliminated. Interesting effects are also shown to be produced when one filter is placed over the light source and another, crossed with relation to the first, over the camera. For this exhibit, the Hood Medal has been awarded to Edwin A. Land.

Of educational exhibits is one by P. C. Smethurst illustrating the growth of convection currents from an electric heater immersed in a tank of water. Prints of individual states are shown and a 16 mm. motion film has been made. In another educational film, L. A. Jones shows, by the new Kodachrome colour process, growing crystals photographed through a polarising microscope. A medal has been awarded for this film.

Nor do the technical exhibits of some photographic manufacturers lag behind in explanatory value. The enormous exposure range of modern photographic materials used for ordinary photography is well illustrated by Ilford, Ltd. The same theme is taken by the Eastman Kodak Co. in relation to their automatically controlled reversal process for sub-standard cinematography. Another exhibit by Ilford, Ltd., illustrates the use of special materials for recording atomic disintegration and for mass spectrography.

In colour photography several processes are represented. Agfa Colour, Finlay, Dufay Colour and Kodachrome, of the colour transparency processes, are all represented, whilst for colour prints on paper examples of Tricolour Carbro, Vivex, Raydex and Duxochrome may be seen.

High-speed photography is this year well represented by studies of a football as it is kicked, and a tennis ball at the impact of the racquet—the ball is almost hemispherical. Exposures of 1/100,000 sec. were used for these (K. J. Germeshausen, H. E. Edgerton and H. E. Grier). Another excellent series by A. M. Rothrock and E. C. Buckley records for the first time the injection and combustion of the fuel in a high-speed Diesel engine; for this a special motion picture camera is used in which the time interval between frames is 1/2,500 sec.

Swelling of Colloids

IN the August number of the *Berichte der chemischen Gesellschaft*, Prof. H. Staudinger and Herr E. Husemann describe interesting experiments on the behaviour of certain polymerised olefines towards solvents.

It is a remarkable fact that among colloids of high molecular complexity one may find substances apparently identical in composition but possessing very different properties. In a previous paper (1934) it was shown that styrene yields two dissimilar polymers, one of which swells continuously in a given solvent until it dissolves completely, whereas the swelling power of the other is strictly limited. In the latter case, the original form of the polymer is retained after swelling, although the volume may be increased fifty- or hundred-fold, but it remains undissolved. It was found that this insoluble variety with limited swelling power is only produced when small amounts of divinylbenzene are present in the styrene, and the theory was advanced that the soluble form consists of long thread-molecules, whereas in the other case more complex 3-dimensional structures are formed.

Further study has shown that the thread-molecules are long, rigid, elastic structures, not easily deformed but soluble forming viscous solutions. When these threads are linked together by divinylbenzene bridges they may form insoluble 3-dimensional molecules unless the amount of bridging is very minute, when the effect is to produce still longer soluble threads. The products with limited swelling-power are now regarded as tangled, felted mixtures of insoluble bridged products with soluble threads. Complete extraction of the threads by the solvent is prevented by the felting. The investigation of these complex polymers has necessitated the development of a special technique, for which we are mainly indebted to Prof. Staudinger. Methods have already been worked out for the synthesis of a kind of homologous series of colloidal polymers, which are classified according to their molecular dimensions as (1) hemicolloidal, (2) mesocolloidal and (3) eucolloidal polystyrenes with molecular lengths of 20–250, 250–2500 and 2500–10,000 A. respectively. The authors have made an elaborate study of the polymerisation under varied conditions of pure styrene and divinylbenzene and of mixtures of these.

In every case the degree of polymerisation was determined by viscosity measurements, and it has been found possible to determine the minimum amount of divinylbenzene required to produce a polymer with limited swelling-power.

Educational Topics and Events

BIRMINGHAM.—Colonel H. F. Humphreys has been appointed to the recently created chair of dental surgery. He was formerly lecturer in dental anatomy and curator of the Odontological Museum in the University.

CAMBRIDGE.—The following committee has been appointed to advise the Council of the Senate in their choice of a Jacksonian professor of natural philosophy :—the Vice-Chancellor, W. Spens, Prof. Lennard-Jones, H. Thirkill, Prof. G. I. Taylor, Sir Frank Smith, Lord Rutherford, Sir William Pope and Lord Rayleigh.

The following resignations or retirements are announced :—J. T. Saunders, lecturer in zoology; A. A. Miles, demonstrator in pathology; Dr. A. E. Barclay, lecturer in medical radiology and electrology; T. G. Room, lecturer in mathematics; Dr. J. Chadwick, lecturer in physics; Dr. N. Feather, demonstrator in physics; H. N. Green, demonstrator in pathology; R. H. D. Mayall, lecturer in mathematics; Dr. G. F. C. Searle, lecturer and demonstrator in physics; Dr. S. M. Manton, demonstrator in comparative anatomy; E. H. B. Boulton, lecturer in forestry.

R. Passmore has been elected Gwynaeth Pretty student, and Dr. M. E. Adair, of Girton College, John Lucas Walker student.

The John Wimbolt Prize has been awarded to E. D. Ward, of Gonville and Caius College, for a dissertation on "The Thermal Properties of Metals and their Engineering Significance".

At St. John's College, J. S. Marshall, Queen's University, Ontario, has been elected to an exhibition for physics, and G. H. Twigg, University of St. Andrews, to one for chemistry.

At Emmanuel College, the external studentship has been awarded to J. C. Bower (University of Melbourne), for physics.

AN account of the development of the Department of Industrial Administration in the College of Technology, Manchester, by Dr. K. G. Fenelon, has been reprinted from the "Year Book" of the Manchester College of Technology Old Students Association. The Department was founded in 1918 through the co-operation with the governing body of the College of eleven firms each of whom contributed an annual sum of £100, and was developed with the special object of providing facilities for training in the broad underlying principles of management and administration. For the first few years, the Department's activities under the direction of Dr. Stanley Kent were largely devoted to research, but Mr. Dempster Smith who succeeded him as director in 1921 proceeded to develop the teaching side. Evening courses were then established, including those on administration for engineers and administration for chemists, and a full-time two-year day course in industrial administration was introduced, which in 1926 was recognised for the associateship of the College. In 1926 a University post-graduate course in industrial administration was commenced, the first course of its type to be provided in Great Britain, and in the same year the Department was taken over entirely by the College, the original guarantors, with certain changes, continuing to act as an Advisory Committee. Dr. James A. Bowie succeeded Mr. Dempster Smith as director in 1926 and was followed in turn by Dr. K. G. Fenelon in 1931. Research at present in progress includes scientific management in textile mills, budgetary control, works organisation with special reference to engineering industries and administration and organisation of transport enterprises. Experiments have been made with the 'case method' of instruction, and the full-time courses include weekly study visits to factories, offices and business enterprises.

SCHOOLS of the largest size are to be found, as is well known, in American cities. A recent monograph on the elimination of very small schools (Bull. No. 3, 1934, of the Office of Education) reveals the surprising facts that in the United States more than 7,000 State schools have not more than five pupils each and 1,000 have only one or two. Moreover, in some States the number of such very small schools tends to increase with the substitution of larger farms for smaller and rural depopulation. At a time when school costs are bearing heavily on reduced revenues, the expensiveness of maintaining these diminutive units is directing attention to various schemes for eliminating them. Consolidation into larger units of the ordinary type is among many communities impracticable because transportation facilities cannot be provided. Considerable interest has in recent years been aroused by the use of postal tuition for secondary education, and the question has now been raised whether such correspondence lessons might not with advantage replace many of the excessively small and costly rural schools. Australian and Canadian public school administrators are well satisfied with the results of primary education by correspondence under schemes which have been in operation for some fifteen years in Australia and British Columbia and seven years in Alberta, Saskatchewan and Manitoba. A comprehensive account of the Australian schemes was published in 1931 by Melbourne University Press in association with Messrs. Macmillan and Co., Ltd. The author, Dr. K. S. Cunningham, while admitting that children so taught miss some valuable social experiences, was impressed by the compensating advantages accruing from the intellectual independence fostered in them through having to tackle their work without the present aid of a teacher.

Science News a Century Ago

The Association of German Naturalists

WRITING from Bonn on September 28, 1835, to the *Athenæum* about the German Society "Der Naturforscher und Aerzte" which had just finished its meeting, a correspondent said: "The proceedings of this body must necessarily excite an increasing interest, when its offspring, the British Association, has been growing to its present colossal dimensions, although the subjects and discussions at these Meetings are less comprehensive than at the Association, being confined to Natural History in its widest extent, Anatomy and Chemistry. The results of both have been crowned with a success little expected by those who projected them". Among the most distinguished men of science at Bonn were Von Buch, Elie de Beaumont, Constant Prevost, Alexandre and Adolphe Brongniart, Littrow, Audouin, Ritter, Jussieu, Ampère and Weber, the British men of science including Buckland, Lyell, Horner, Greenough, Gregory and Turner. The first

general meeting was held on September 18; the sectional meetings began on September 19. There were various expeditions, and during the last of these on September 26 Buckland and Von Buch were hurt in a carriage accident.

Writing of the papers in the Sections, the correspondent of the *Athenaeum* said: "The Geological was, as usual, the most popular. The question of elevated craters relating to the much-disputed theory of Von Buch, was discussed at length, and somewhat hotly, the leading speakers being Elie de Beaumont, Lyell, Prevost and Von Buch himself." Very beautiful drawings of Etna and Vesuvius were exhibited and described by Dr. Abich, of Brunswick, while among other topics discussed were Schmerling's discoveries in the bone caverns of Liége, Van Hoff's remarks on the footmarks in sandstones at Hildberghausen, and Buckland's views on the Dinotherium and on the identification of certain beds south of Liége with the Silurian system of Murchison.

"The disposition to conviviality which you noticed in the account of the Dublin Congress was not wanting in Bonn; in this respect the family likeness is most striking: eating and drinking, and giving of toasts, were by no means the least important occupations of the day. . . . The last toast which was given at Bonn, was by Dr. Froriess, of Weimar, 'The British Association and its former president, Dr. Buckland', which was drunk with enthusiasm".

Littrow Observes Halley's Comet

ON October 17, 1835, *The Times* published the following note: "Vienna, Oct. 3. This morning Halley's Comet was perfectly visible to the naked eye as a star of the third magnitude, with scarcely any nebula about it. But seen through the telescope, it looked like an extensive nebula, the largest diameter of which was about 15 minutes, or half the diameter of the sun, with a very bright pretty scintillating nucleus, but still without any considerable tail. . . . As the light of the comet has so much increased within a few days, we may expect that it will be a very fine object in the second half of October. C. L. Littrow."

Baily's "Account of Flamsteed"

IN astronomical circles in 1835, the publication of Baily's "Account of Flamsteed" was regarded with an interest secondary only to that shown in Halley's comet. Admiral W. H. Smyth (1788–1865) was among the early readers of the book, and on October 3, 1835, he wrote from Bedford to Mrs. Somerville: "How remarkable that the month of August this year should rattle Halley's name throughout the globe, in identity with an astonishing scientific triumph, and that in the self-same month the letters of Flamsteed should have appeared! How I wish someone would give us a life of Newton, with all the interesting documents that exist of his labours! Till such appears, Flamsteed's statements, though bearing strong internal evidence of truth, are *ex-parte*, and it is evident his anxiety made him prone to impute motives which he could not prove. The book is painfully interesting, but except in all that relates to the personal character of Flamsteed, I could almost have wished the documents had been destroyed. People of judgment well know that men without faults are monsters, but vulgar minds delight in seeing the standard of human excellence lowered".

Societies and Academies

PARIS

Academy of Sciences, August 5 (*C.R.*, 201, 369–412). LOUIS DE BROGLIE and JEAN LOUIS DESTOUCHES: The theorem of Kœnig in wave mechanics. CHARLES NICOLLE and J. LAIGRET: Vaccination against exanthematic typhus by the living typhus bacillus, dried and coated. HENRI LAGATU and LOUIS MAUME: Variations of the physiological ratios in correlation with the disease of 'wild fire' in the tobacco leaf. Chemical differences are disclosed by the analysis of the healthy and diseased leaves, the alteration in the potash to nitrogen ratio being particularly marked. It is not yet clear whether the changes in the ratios are a cause, or a symptom, of the disease. SVEN GULDBERG: The formulæ of recurrence of the semi-invariants of Bernoulli's law and of Pascal's law with n variables. CONSTANTIN POPOVICI: The periodic solutions of S. Chapman's equation. G. BOURION: The ultra-convergence of integral series. RENÉ RETEL: Remarks on detonation in Diesel motors. The phenomenon has been studied using the Serruys optical manograph with small inertia, and, from the results, suggestions for avoiding detonation are deduced. It would appear that the presence of light products arising from cracking the fuel is the cause of detonation. MIROSLAV NÉNADOVITCH: The characteristics of certain rigid biplane cells of infinite spread. BENJAMIN GUREWITCH: A method for the study of magneto-strictive vibrations. PIERRE MESNAGE: The molecular emission spectra of some metallic salts. The spectra of the chlorides of iron, chromium and cobalt. ANTONIN ANDANT, PIERRE LAMBERT and JEAN LECOMTE: The diffusion spectra (Raman effect) and infra-red absorption spectra of saturated fatty alcohols and ethylene hydrocarbons. The Raman spectrum gives a characteristic line with the double bond: the infra-red spectrum gives two lines characterising the tertiary alcohol function. The two methods together distinguish between successive homologues and isomers. MAURICE BONZEL: The deformations accompanying the thermal treatments of cold-hardened metals. GEORGES ARDITTI: The autoxidation of normal hexadecane. Study of the oxidation of the liquid hydrocarbon at varying temperatures. For all the temperatures studied, the commencement of oxidation is accompanied by production of carbon monoxide in predominating amounts. More oxygen is used than can be accounted for in the gases produced. HENRI LONGCHAMBON: The structure of the Cevennes in the region defined by the Largentière sheet on the scale of 1/80,000. B. CHOUBERT: The Cretaceous formations of the coastal zone of Gabon. JACQUES FLANDRIN: Some features of the middle Eocene Algerian palæogeography. A. CHARLES HOLLANDE: The structure of the nucleus and its constituents: their homologation with the nucleosomes of the Schizophytes (Bacteriaceæ and Cyanophyceæ). HENRI COLIN and MLLE. ANDRÉE CHAUDIN: The diastatic hydrolysis, *in situ*, of the intercellular cement. EMILE MIÈGE: The constitution and descent of the polycarpic strains of *Triticum vulgare*. NICOLAS METALNIKOFF: The bactericidal power of water submitted to the combined action of metallic silver and a continuous electric current. The passage of a continuous electric current, 0·3–4 milliamperes under 1·5–4·5 volts, with a metallic silver anode, confers strong bactericidal

properties on water in a few minutes. Such treated water, after one to three hours contact, kills bacilli of coli, cholera, paratyphoid, typhoid and staphylococcus. The bactericidal property remains after boiling. No taste is imparted to the water, and from experiments on mice it would appear that it has no injurious effects on the organism.

CRACOW

Polish Academy of Science and Letters, July 1. W. M. JEZEWSKI, M. WIERZBICKI and J. KAMECKI: The dielectric constants of strong electrolytes of low concentrations at varying temperatures. The experimental results obtained with solutions of sodium chloride, potassium chloride, magnesium sulphate and barium ferrocyanide are in good agreement with the theory of Debye and Falkenhagen, if the orientation of the dipoles by the intense field of the ions is taken into account. T. PIECH: The dielectric polarisation of some alums. B. MILIANCZUK: The radiation of a magnetic dipole. B. MILIANCZUK: The diffraction of light in the neighbourhood of the lines of the magnetic dipoles. MME. W. CZAPSKA-NARKIEWICZ: The absorption spectra and fluorescence of some coumarin derivatives. B. KAMIENSKI and W. GOSLAWSKI: The influence of hydrogen ions on the dielectric potential and surface tension of solutions of some organic substances. L. MARCHLEWSKI and B. SKARZYNSKI: Absorption of ultra-violet rays by certain organic substances (40). L. MARCHLEWSKI and B. DABROWSKI: The determination of very small quantities of zinc by the spectrographic method. ST. KREUTZ: Calcites and other minerals characterised by their luminescence. K. DZIEWONSKI, L. GIZLER and J. MOSZEW: The reactions of some mixed aromatic ketones with bisubstituted thiourea derivatives containing different aromatic radicals. T. DOMANSKI and J. SUSZKO (1): Some transformations of the isoquinidines. (2) Niquidine. H. TELEZYNSKI: Cytological studies on an unstable strain of *Petunia violacea*. ST. MARKOWSKI: The parasite worms of *Gobius minutus* of the Polish Baltic. MME. IRÈNE LATINIK-VETULANI: Experimental researches on anoxybiosis in the different stages of development of *Rana fusca*.

ROME

Royal National Academy of the Lincei, April 7. MARGHERITA PIAZZOLLA-BELOCH: The asymptotes of a plane algebraic curve in relation to the theory of diameters. B. COLOMBO: An equation with partial derivatives of the fourth order. J. REY PASTOR: The quasi-continuous convergence of successions of functions. G. MARLETTA: Reflections on differential projective geometry. C. TOLOTTI: Einstein's gravitational equations for dynamic universes endowed with complete symmetry about a centre. A. FENICI: Centres of gravitation and centrobaric bodies. R. L. GOMES: A property of de Broglie's operator, H. O. ZANABONI: Determination of critical loads by means of the principle of virtual work. F. ZAGAR: The orbit of a third invisible body in a binary system. The utilisation of measurements of radial velocities to deduce the existence and the orbit of an invisible body revolving round one of the two components of a binary system is considered. Under definite conditions, it is possible to derive, not only the orbital plane of the invisible body, but also all the other elements except the major semi-axis. F. ODONE: Thermodynamic foundations of the theory of electrical equilibrium and of the permanent currents in metallic conductors. F. PIRRONE: Alicyclic compounds (1). Synthesis of β-ketoamines. The products obtained by the interaction of benzaldehyde, ammonia and cyclohexanone indicate that, in this reaction, the equilibrium between the enolic and ketonic forms of cyclohexanone is displaced towards the ketonic form. F. DULZETTO: New observations on the life and relation between the sexes in the young of *Gambusia holbrookii*, Grad. I. DELPINO: Notes on the diffusion of *Trutta genivittata*.

SYDNEY

Royal Society of New South Wales, August 7. G. O. K. SAINSBURY: Vegetative reproduction in New Zealand mosses. Twenty species are recorded as having peculiar brood-bodies or gemmæ on the leaves. These organisms become detached, and develop into a thread-like growth, and are eventually formed into lateral or terminal growths similar to what are known as bulbils. These structures are capable of developing into separate plants, and thus form populations by this means instead of the usual spore germination methods of reproduction.

Forthcoming Events

Monday, September 30

ROYAL SOCIETY OF MEDICINE, at 5.—W. Trotter: "General Ideas in Medicine" (Lloyd Roberts Lecture).

Official Publications Received

Great Britain and Ireland

Battersea Polytechnic. Department of Hygiene and Public Health Calendar for the Session 1935–1936 Pp. 18. 3*d* Domestic Science Department and Training College Calendar for the Session 1935–1936 Pp. 32 3*d*. Technical College for Day Students and Day School of Arts and Crafts. Calendar for the Session 1935–1936. Pp. 50. 3*d*. Evening and Afternoon Courses and Classes. Calendar for the Session 1935–1936. Pp. 30. (London: Battersea Polytechnic.)

The Institution of Automobile Engineers: Research and Standardization Committee. Fourth Annual Report, July 1st, 1934—June 30th, 1935. Pp 19. (London: Institution of Automobile Engineers.)

Other Countries

The Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 and previous "Dana" Expeditions. Dana-Report No. 7: Quantitative Investigations on the Distribution of Macroplankton in different Oceanic Regions. By P. Jespersen. Pp. 44. (Copenhagen: C. A. Reitzels Forlag, London Oxford University Press.)

Colony and Protectorate of Kenya: Department of Agriculture Bulletin No 2 Diseases of Cereal Crops in Kenya Colony. By C A. Thorold Pp. v+66+16 plates (Nairobi Government Printer.)

U.S. Department of Agriculture Circular No 356: Trapping Experiments for the Control of the Cigarette Beetle By W. D. Reed, A W. Morrill, Jr, and B. M Livingstone. Pp 14. (Washington, D C Government Printing Office.) 5 cents.

Pubblicazioni della R. Università degli Studi di Firenze Fascicolo N 53: Osservazioni e Memorie del R. Osservatorio Astrofisico di Arcetri. Pp. iv+64+1 plate. (Firenze: R. Università degli Studi.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil, Vol. 10, No 2. Redigé par E. S Russell Pp 145–241. (Copenhague: Andr. Fred. Høst et Fils.)

Publications of the Dominion Observatory, Ottawa Vol 12 Bibliography of Seismology. No. 5. January, February, March, 1935 By Ernest A. Hodgson. Pp. 97–114. (Ottawa: King's Printer.) 25 cents.

Über die Ursache der Niederschlagsschwankungen in Europa und ihre Beziehungen zu anderen meteorologischen Faktoren. Von Rudolf Hohn. Pp. 64. Die 20 tagige Welle des Winters 1928–29 Von Werner Pflugbeil Pp. 77. (Leipzig: Geophysikalisches Institut der Universität.)

Académie des Sciences d'Ukraine: Institut de la Mécanique des Constructions. No. 14. Méthodes approchées de la mécanique non linéaire dans leur application à l'étude de la perturbation des mouvements périodiques et de divers phénomènes de résonance s'y rapportant. Par Prof Dr. Nicolas Kryloff et Dr Nicolas Bogoliûboff Pp. 113. (Kiev: Akadémie des Sciences d'Ukraine.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3440 SATURDAY, OCTOBER 5, 1935 Vol. 136

Organisation of Agricultural Research

STATE assistance to agricultural research in Great Britain began with the Development Act of 1909, and in accordance with the principle of that Act, the finance of the schemes then initiated remained with the Development Commission, while the administration rested with the departments of agriculture, until in 1930 the Agricultural Research Council was set up. This council, though equally under the Privy Council, has not quite the same status as its parallel bodies, the Department of Scientific and Industrial Research and the Medical Research Council, both of which administer directly the whole of the funds available from the Treasury for research in their subjects. It would be difficult to explain to a foreigner the curious machinery which now prevails for the purpose of making grants, involving as it does the Research Council, the Development Commission, the two departments of agriculture in England and Scotland, and finally the Treasury.

A recent article in *Planning* is very insistent on simplification, on the ground that all these separate strands of red tape not only result in delay in the consideration of applications for grants, but also are obstacles to the proper planning of agricultural research. Of course, no one would devise such an organisation *de novo*; it grew by stages, its excuse is the dread all Governments have of legislation, its justification is the necessity of maintaining continuous touch between the research workers and the agricultural departments, the administration of which should be guided by the conclusions reached by research. It may be doubted whether delays are greater than in any other dealings with a Government department. Speed of action is the attribute only of an autocracy, and of an autocracy on a small enough scale to allow of immediate access to the autocrat.

As to planning, it was for that purpose the Research Council was set up; it surveys the whole field, it reviews the work of each Institute, and though that Institute may be financed by the Development Commission and administered by the Ministry of Agriculture, it would scarcely be able to ignore the recommendations or criticism of the Council. As the writer in *Planning* admits, the cumbrous organisation is being made to work, and so it will remain until there comes along some Government willing to spare some of its precious 'time' in order to secure order and logic in its machinery of administration.

The article also discusses the failure to obtain any substantial addition to the funds for research from the farming community, but that is inevitable because of the way the industry is split up into small units of production. The Marketing Boards do possess powers of making a levy on their very considerable turnover that would raise ample funds for research, without imposing any perceptible burden upon the individual, but the awkward administrative question of reconciling the responsibility of the Council for the direction of research with the power of the purse possessed by the Marketing Boards is still unsettled.

The most weighty criticism of the *Planning* article is directed against the indifferent scale of salaries prevailing in the research institutes, which it is alleged are failing to attract men of initiative and high mental capacity. But as the head of one of our universities has pointed out, only a small fraction of the men who graduate each year are really of the first grade, a fraction well below the demand that is made upon the universities by the various services, business and professions. When, however, all allowance is made for this and for the fact that research

offers a sheltered career with an attraction of its own, irrespective of income, there is undoubtedly much dissatisfaction among the agricultural research workers, a small body not more than five hundred in all, a large proportion of whom are not established. There is need for an unbiased review of the situation, and this is presumably within the reference of the Research Council. Agricultural research workers do need favourable terms, for they have few outlets for escape into well-paid business. It is precisely this alternative which renders recruiting for research in veterinary medicine so difficult in the veterinary profession; the great increase in administrative appointments of recent years has offered to any graduate of quality prospects much superior to those the research institutes can offer.

We doubt if the suggestion that the Research Council itself ought to appoint super-directors of its own for each group of subjects is helpful. The man in charge of a research station, the man who is immersed in the subject, may be guided and may benefit from the critical examination of his work by men of quality in the cognate pure sciences, but he cannot be made to work to order or forgo his responsibility. If one believes in research, one must trust the research worker's personality. The practical outcome of such a plan would be to withdraw the few outstanding men of originality from the active prosecution of research into administration.

The real function of the Research Council is not to control research nor to manage the research workers; it is to survey the field as a whole and to think out priorities, and to bring an enlightened judgment to bear upon the many proposals put before the Council. It has to decide whether the possibilities offered by the project are of the order of probabilities, and how far the pursuit of pure knowledge has an economic justification. Sometimes it will see a neglected opportunity, sometimes it must override a director in the interests of a more comprehensive organisation, sometimes it must advise a director that an investigation is becoming a routine, a blind alley. But ultimately it has to recognise that research is the product of the imagination and insight of individuals; its highest wisdom is to back the right horse.

Finally, the writer in *Planning* directs attention to the weakness of the organisation for getting the results of research passed over to the farmer and translated into action. It is a question which troubles the agricultural administration in every country, and particularly obsesses the public men concerned with agriculture. The inherent difficulty lies in the fact that agricultural production is split up among a number of relatively weak units, limited by lack of capital and personality. In agriculture there are no great corporations the resources of which enable them to take a long view about the adoption of a new process. The educational service which is in direct contact with farmers is outside the purview of the Research Council, and is doing excellent work. But the industry will have to become organised before it can reap the full harvest of research; as the Marketing Boards gain experience, they will be able to press upon the producers, their members, the improved methods that are the outcome of investigation and knowledge.

Study of Crystal Structure

A Study of Crystal Structure and its Applications

By Prof. Wheeler P. Davey. (International Series in Physics.) Pp. xi+695. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 45*s*. net.

AFTER a rather quiescent period, the study of crystals sprang into great activity as soon as it was discovered that crystalline materials could be used as three dimensional gratings for radiation of the wave-lengths of X-rays. The earlier work of crystallographers on the theory of space groups was presented in forms more useful for the new developments by Wyckhoff and by Astbury and Yardley. The Laue and Bragg methods, and the powder photographic method, were employed in the analysis of the internal structures of the simpler substances, and the subject advanced at a rapid rate.

As the substances examined increased in complexity, more data had to be obtained to permit of the deduction of their structures. Rotation and oscillation photographic methods were developed, special types of camera designed and much ingenuity displayed in devising reasonably quick graphical methods of interpreting the photographs; as

examples, may be quoted, on the practical side, the Weissenberg camera, and, on the theoretical side, the conception of the reciprocal lattice.

The extension of our knowledge of atomic structure factors enabled considerations of the intensities of the reflected beams to add their full quota towards structure determination. The Fourier analysis method, first suggested by W. H. Bragg, was developed by many investigators and, in the hands of W. L. Bragg and his school, formed the basis of the determination of the structures of the complex silicate groups. All these problems are dealt with by W. P. Davey in the first half of this book. In view of the increasing importance of intensity measurement, however, it would have been appropriate, perhaps, to find room for some reference to improvements in intensity determinations of photographically recorded reflections.

If enough were known concerning the fundamental properties of matter, it ought to be possible to calculate the physical and chemical properties of crystalline materials, and in illustration the author considers the refraction of light by crystals, and more particularly W. L. Bragg's calculation of the optical constants of calcite and aragonite.

Atomic sizes, lattice energies, diffraction by amorphous materials, polycrystalline texture and solid solutions, all find their places in the text, but liquid crystals and fibre structures might have received more detailed consideration.

Of particular interest at the moment is the study of the imperfections of real crystals, that is, their deviations from ideal lattices. This involves much more than X-ray observations alone and, quite justifiably, a whole chapter has been devoted to this subject. It is unfortunate, however, that the chapter deals so fully with Zwicky's secondary lattices, a conception which is now generally considered to be built upon a rather unsafe foundation, while other hypotheses receive scant mention.

The volume concludes with four appendixes, of which the first gives a limited account of apparatus for the production of X-rays, the second deals with charts for use in the interpretation of powder photographs and the third records space group tables. The author disclaims any use for the Hermann Mauguin symbols, but, after devoting three pages to their reproduction, it seems a pity that he does not give a word in explanation of the individual symbols the various combinations of which form the complete space group notation.

R. E. GIBBS.

Herpetology: Popular and Systematic

(1) Reptiles of the World:
the Crocodilians, Lizards, Snakes, Turtles and Tortoises of the Eastern and Western Hemispheres. By Dr. Raymond L. Ditmars. New revised edition. Pp. xx+321+90 plates. (London: John Lane, The Bodley Head, Ltd., 1933.) 18*s*. net.

(2) A Monograph of the Frogs of the Family Microhylidae
By H. W. Parker. Pp. viii+208. (London: British Museum (Natural History), 1934.) 15*s*.

(1) THIS well-known book has long been recognised as a standard work on reptile life, and the several reprints which have appeared since its first publication in 1910 testify to its wide popularity and usefulness. In the preface of the revised edition, the author once more expresses the hope that the book will be "everywhere in accord with the latest results of the scientific study of the subject". However, the new edition contains very little new information, and recent herpetological literature is not well covered. Thus, in treating of the Opisthoglyph snakes, the author speaks of "the absence of records to show what their venom is capable of doing", though Fitzsimons (1919) has recorded the potency of Boomslang venom. Besides being dangerously poisonous to man, this is a familiar and abundant South African species which might well have been mentioned here.

It is a source of disappointment to find that the author's experiences in the field, and his unique observations on the feeding, care and treatment of reptiles in captivity during the twenty-three years since the first edition appeared, have not found a place in the new edition of his work. While the nomenclature has been brought up to date, the revision is unfortunately inconsistent: it will be misleading to readers unfamiliar with the subject to see the same genus mentioned within a few lines of print under the two names *Glauconia* and *Leptotyphlops*, while the largest genus of skinks is inconsistently referred to as *Lygosoma* and *Leiolopisma* in different parts of the book.

Misprints appear to be few: the following should be rectified in the next edition: "comical", p. 29 (conical); "Abamidae", p. 33 (Agamidae).

The revision might well have been extended to correct a number of awkward expressions (such as that on p. 43, where we read: "One generally anticipates an awakening of insect life with the coming of darkness, and he is not disappointed") and grammatical errors (such as the use of "dove" for "dived"). Throughout the book "habitat", a word which normally has an ecological rather than a geographical significance, is incorrectly used for "distribution".

Referring to the parallelism of characteristic genera in the Old World Agamidae and the New World Iguanidae, we do not agree with the author's statement "This in no way relates to adaptation". It is significant that many of these unrelated lizards resemble one another, not only in outward appearance, but also in habits and habitat, and this similarity—as, for example, in the arboreal *Agama atricollis* and *Uraniscodon plica*, the desert-dwelling *Moloch* and *Phrynosoma*, and the cursorial *Liolepis* and *Dipsosaurus*—is probably the result of adaptation to a similar mode of life. It would be interesting to have reliable evidence (which is yet lacking) for the belief, here repeated, that the lateral skin-flaps of the gecko *Ptychozoon homalocephalum* "serve the animal in parachute-like fashion, enabling it to make long, scaling leaps from tree to tree". One function of these flaps is certainly cryptic, in that they tend to eliminate the gecko's shadow, and thus add to the effectiveness of its resemblance to lichen-covered bark.

The shortening of the book by some fifty pages is a doubtful improvement, for it has been made at the expense of the bold type which characterised the earlier edition, and which is here replaced by smaller and less clear print. A fine study of *Varanus komodoensis* appears on the frontispiece: otherwise the illustrations are the same, and the steep-angle photograph of *Natrix natrix* reappears upside-down on plate 38. The plates have now been conveniently collected at the end of the volume, and the printers' rendering of the author's many excellent photographs on a better quality paper is a distinct improvement on earlier editions.

(2) In making this much-needed revision, now published as "A Monograph of the Frogs of the Family Microhylidae", Mr. H. W. Parker has successfully accomplished a difficult task. The work has evidently been prepared with great care, and it comes well up to the high standard which one associates with publications sponsored by the trustees of the British Museum. Embodying as it does the latest ideas on the classification of this group of frogs, it will be welcomed by students of herpetology, for it represents the first complete account of the family written in English since the publication in 1882 of Boulenger's well-known "Catalogue of the Batrachia Salientia", which accounts for less than one quarter of the species of the family known to-day.

During the past fifty years, various schemes of classification have been proposed, only to be rendered in turn more or less obsolete by the progress of research and with the accumulation of fresh material. Earlier classifications were found unsatisfactory because they were based upon characters later shown to be unreliable. The author has had access to ample material comprising the large majority of known species, and his classification of the group will be the more valuable on that account.

The introductory section (pp. 1–18) opens with a historical résumé of the family. This is followed by a detailed account of the characters, mainly osteological, to which taxonomic importance is attached. The larval stages (known in relatively few species) are considered in their bearing upon a natural classification of the group. Seven subfamilies are now recognised—an arrangement which expresses the inter-relationships of the various genera, and which, the author tells us, "has the merit of according with the facts of geography as well as of morphology". The present distribution of the family is discussed in relation to its past distribution in time and space, of which, in the entire absence of fossils, our knowledge must largely rest upon a foundation of conjecture rather than of fact.

The second and main section of the work (pp. 19–200) contains the systematic account of the 184 species, which are assembled into forty-three genera. Under each of the latter, the author gives a list of references—the type species being designated—a definition of the genus, and a synopsis of the contained species. For each species, there is a synonymy referring to all the more important papers, the locality of the type specimen being given. Following the description, there is a statement of the known distribution, and a list of the specimens (in all, more than 1,600) actually examined by the author, with particulars as to source, date, sex, locality, and the collector's name where this has been traced. A number of clear original text figures and a very complete index add materially to the usefulness of this well-arranged and well-printed volume.

To the systematic herpetologist Mr. Parker's work will be indispensable: but it is to be hoped that the book—providing as it does an excellent and trustworthy means for identification—will also stimulate a wider interest in this large but obscure group of frogs, the habits and life-histories of which are little known.

HUGH B. COTT.

Vitamin B in the Diet of Man

The Vitamin B Requirement of Man

By Prof. George R. Cowgill. (Published for the Institute of Human Relations.) Pp. xix + 261 + 4 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1934.) 18*s*. net.

THE title of this book is so intriguing that all who are interested in nutrition will wish to know how the author has arrived at such a definite assertion, especially in view of the fact that man's requirement for vitamin B cannot be studied by direct experimentation.

Dr. Cowgill has attempted the problem indirectly. He has ascertained the minimum vitamin B requirement of different species of animals (rat, mouse, pigeon, dog) in terms of a special yeast preparation, using animals of widely different weights. His data pointed to the minimum vitamin B requirement being related to some power of the body weight. By trying various values for this power, he found that the figures agreed with the expression vit. $B = K \times Wt.^{5/8}$, and that there was a factor common to all the species. Bringing into account the maximum normal size of the different animals, the expression became vit. $B = 4{\cdot}9 \times W^{0{\cdot}66} \times \frac{W}{W_{max.}}$ and it agreed remarkably with the experimental figures. As $W^{0{\cdot}66}$ may be taken to indicate metabolism, since basal metabolic rate and body surface are functions of the 2/3 power of the body weight, and as from food intake figures Calories $= 1{\cdot}5 \times W^{0{\cdot}66}$, the expression becomes vit. $B = 4{\cdot}9 \times \frac{\text{Cal.}}{1{\cdot}5} \times \frac{W}{W_{max.}}$. Since $W_{max.}$ is a constant, the formula reduces to vit./Cal. $= K \times W$. For man, taking 115 kgm. as the maximum weight, the formula is vit./Cal. $= \frac{3{\cdot}27}{115{,}000} \times W$, or $0{\cdot}0000284\ W$. The vitamin is taken in milligrams of the special preparation and the weight in grams. It should be noted, though not mentioned by Cowgill, that a vitamin/carbohydrate ratio was suggested by Randoin and Simonnet and a vitamin/Calorie ratio by Plimmer, Rosedale and Raymond, who considered that it should have a constant minimal numerical value.

By plotting vit./Cal. ratios as ordinate against weight as abscissa and using the line given by the maximum weight of 115 kgm., a series of ratios are given for different body weights. Reference to the chart shows the vit./Cal. ratios of 1·25, 1·50, 1·75, 2·00 corresponding to weights 40, 50, 60, 70 kgm. respectively. The minimum ratio for a man of 70 kgm. is thus 2·00. Figures near the line are border-line, figures above show sufficiency and below too little vitamin B.

To check the accuracy of the vit./Cal. ratio, Prof. Cowgill has collected together the diets of peoples in various parts of the world which did and did not give rise to beriberi. Beriberi is due to a deficiency of vitamin B in the diet. These diets have been evaluated for their vitamin B content in terms of the special yeast preparation. Foodstuffs had been tested by other workers, some of which had been tried by all the workers and also by Cowgill. It was thus possible to calculate all the figures on the same unit. A useful table of these values is given, and it is possible to recalculate the figures in terms of other units, or the international unit, as a table is shown giving the approximate equivalents of the various units. The vit./Cal. ratio of any diet could thus be determined.

The diets of the sufferers from beriberi had vit./Cal. ratios of 1·74, 1·96 to 2·18, 1·35 and lower values. Diets on which beriberi did not appear had the corresponding ratios of 2·18, 2·26 to 2·46, 1·97, 2·96. These figures agree closely with those shown on the chart. Occasionally there were discrepancies, but on referring to the weight it was found that the weights of the individuals were either above or below the chart line. An examination of a series of diets consumed in the United States showed the vit./Cal. ratios of 2·01–3·39. The value of 2·05 is regarded as borderline for a man of 60–70 kgm.

Though many workers will not agree with Cowgill's method of trying to fix a vitamin B–Calorie ratio as a means of determining the vitamin B requirement of man, yet it must be granted that an analysis of the diets leading to, or preventing, beriberi for their vitamin B content is an essential step. The book gives further details of the occurrence of beriberi since the date of Vedder's book, the diets of the peoples in the beriberi districts and other useful information. A chapter is devoted to other clinical conditions associated with lack of vitamin B. It is hoped that the attention of physicians be directed to the importance of vitamin B to health. It is not correct to believe that there is plenty of vitamin B in the ordinary diet and dismiss it from consideration. The vitamin/Calorie ratio should be checked in cases of enlarged heart, bradycardia and disorders of the digestive tract.

Biochemical Progress

Annual Review of Biochemistry

Edited by James Murray Luck. Vol. 4. Pp. vii + 639. (Stanford University, Calif.: Annual Review of Biochemistry, Ltd., 1935.) 5 dollars.

THE three previous volumes of these reviews have proved of so much value to biochemists that the form of their continuation is a matter of general interest. In no branch of science is there a greater flood of published work, more need of analysis and a better chance of an unexpected discovery illuminating further progress. The subject is essentially fluid, and reviews under stereotyped headings may easily become sterile. Hence the editors have encouraged the policy of analysis of selected papers chosen on account of their intrinsic importance and significance. It is for the reviewers and the readers of reviews to co-operate, the former by selecting and the latter by suggesting subjects which are ripe for comment.

It should be remarked that the three trial years being completed, the enterprise of editing and publishing the "Review" becomes one and the same, and is established as a non-profit earning corporation. It is appropriate to hope that it will receive a generous measure of support from the ever-growing number of British biochemists.

Turning to the recognition of fields of immediate interest, this volume includes reviews on choline and allied compounds by Gaddum, the biochemistry of malignant diseases by Holmes, plant hormones by Thimann. In all, there are twenty-seven reviews by an international assembly of authors.

Enzymes are a subject in which there is annual progress; this time it is reported by J. B. Summer that six enzymes and two zymogens have been isolated in the crystalline state. Enzyme chemistry is becoming more or less identified with protein chemistry, and we are perhaps on the road to clear up some of the facts relating to the higher molecular state of proteins.

The domain of carbohydrates is likewise never without new problems and new discoveries; it is handled by the sympathetic pen of Sir James Irvine, who confines his summary to the more purely chemical developments, leaving for the moment the striking observations connecting polysaccharides with immunological reactions. The synthesis and constitution of ascorbic acid is perhaps enough for one year, but there is much else to chronicle.

As to the proteins and their constituent amino acids dealt with by Edwin J. Cohn, it is noteworthy that progress owes much to physical measurements, particularly X-ray diffraction studies which reveal both the distances between carbon atoms in the chain, and further, the relations between atomic groupings in the peptide and hydrocarbon chains and much else besides. This very important review seeks to set forth principles in terms of which a complete description of behaviour may ultimately emerge.

The sulphur compounds, reviewed by Howard B. Lewis, retain their interest, particularly glutathione with its role as activator or co-enzyme for enzyme activity. The evidence for, and against, the view that the sulphydryl group is a specific stimulus for growth is summarised: it appears to be a promising line of research.

Plant pigments are summarised by R. Kuhn, who has contributed so much to their elucidation. He describes the carotenes with their established formulæ, and shows how the cleavage of the carbon skeleton of a carotinoid with forty carbon atoms yields in theory other natural products, the structure of which depends on the point of cleavage. Four natural pigments are now recognised as provitamin A. The flavins first obtained from milk have been characterised and synthesised; as much pigment has been made from 100 gm. of dimethyl-4-amino-5-methylamino benzene as from 750,000 litres of milk. This shows how advanced is the chemical technique of dealing with minute quantities.

The elucidation of the molecular structure of the alkaloids, particularly morphine and strychnine, is one of the most difficult problems which confronts the chemist. It is one in which he will not admit defeat, and to solve it he tries method after method of attack. The progress is, therefore, steady rather than spectacular; it is appropriately summarised by Robert Robinson.

A new subject for review is that of growth substances in plants, in particular auxin, of which the structural formula has been established. This field may be expected to yield remarkable results in the not too distant future.

Space will not permit of further specific reference, but enough has been said to indicate the utility of the annual reviews and the amazing amount of work which is in progress. The chemist has been accused of war-promoting activities: such are as nought compared with the attempts to understand living tissues which are being made in a thousand and more laboratories.

"Farther, deeper may you read,
Have you sight for things afield."

E. F. A.

Atomic Physics

By Dr. Max Born. Authorised translation from the German edition by Dr. John Dougall. Pp. xii+352. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1935.) 17*s*. 6*d*. net.

IN 1933, Prof. Max Born published in German "Moderne Physik", which has given rise to the present English version by Dr. John Dougall. This book is, however, more than a mere translation, for it has been brought thoroughly up to date so as to include the discovery of new particles and their role in the constitution and disintegration of atomic nuclei. The author has included a clear account of his own views suggesting a higher limit to the possible magnitude of an electromagnetic field, somewhat as the velocity of light appears in physics as the maximum velocity of particles. In this way, Born retains Maxwell's equations and the usual relation between energy and mass, and obtains for the size of the electron $2 \cdot 28 \times 10^{-13}$ cm. and for the absolute field $9 \cdot 18 \times 10^{15}$ E.S.U., but these values may be modified by the effect of spin, which, as he points out, has not yet been satisfactorily dealt with as a real electromagnetic angular momentum from the point of view of his theory. Incidentally, there is on page 46 and appendix vii an ingenious and simple derivation of the Einstein formula $E = mc^2$.

This book gives a comprehensive review of modern atomic physics in 256 pages, while the proofs of formulæ are placed in 31 appendixes (87 pages). The author is careful to point out the limitations and defects of modern theories no less than to set forth their brilliant successes, while he attempts to erect signposts for guidance in future advances.

The relations between the two types of statistics and the symmetric and antisymmetric wave forms are stated with exceptional clearness. The necessarily elusive character of modern views is sufficiently indicated. A wave packet should be almost evanescent, and yet it is possible to hold in the hand a large pitchblende crystal and to state it has remained almost in its present form for 1,400 million years. The microscopic universe is as indeterminate as an animal in the Zoo, when you do not know in which cage it may be, and, if found, the animal dashes off to hide as soon as you try and look at it. Sometimes, however, it leaves a trail, sometimes flashes a light.

A. S. EVE.

The Pineapple

By Maxwell O. Johnson. Pp. xii+306. (Honolulu: Paradise of the Pacific Press, 1935.) 5 dollars.

THE pineapple industry of Hawaii has been built up within the last forty years. In 1896 a large consignment of plants of the 'Smooth Cayenne' variety was imported from Queensland and formed the foundation of the present industry. A few thousand canned fruit were produced by 1902, and by 1913 the production had risen to 2,600,000 cases. It has now reached the enormous total of 12,000,000 cases, or about 300,000,000 marketable fruit per annum.

In 1916 cultivation was confined to the uplands, as plants grown on the lower lands suffered from what was known as 'pineapple yellows'. The discovery by the author that this was due to lack of available iron in the soil, and that the disease could be cured by spraying with iron sulphate, meant an immediate and rapid expansion of the area under pineapples. Other ailments from which the crop suffered have been investigated and largely controlled.

The author of this book, and other technical workers, have been mainly responsible for the maintenance and development of this industry, and there can scarcely be anyone more competent to write a study which deals so admirably with all aspects of cultivation of this crop and which describes in detail the methods adopted to control disease. The book closes with an account of the marketing of both the fresh and the preserved fruit.

This work not only deals with the pineapple in Hawaii but also summarises the experience gained in other countries, many of which have been visited by the author in his search for knowledge of the crop.

Mid-Ice: the Story of the Wegener Expedition to Greenland

By Johannes Georgi. Translation (revised and supplemented by the Author) by F. H. Lyon. Pp. xiv+247+24 plates. (London: Kegan Paul and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THE Wegener expedition to Greenland in 1930 planned to maintain a meteorological observatory on the ice sheet in the heart of the country. The volume before us is the story of how this task was achieved. Transport from the coast, some two hundred and fifty miles away, broke down, but the work at the central station was not interrupted although the party, and at times Dr. Georgi alone, lived in a hole in the ice. They had food, but little else. Here in diary form is the frank record of life under those dreary conditions. Wegener himself lost his life on a journey to the coast; but the expedition has important results. Few of these, however, are given in this general volume, which has its interest chiefly in showing what man can endure in the cause of scientific discovery.

China's Geographic Foundations: a Survey of the Land and its Peoples

By Dr. G. B. Cressey. Pp. xvii+436. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net.

THE author knows China from end to end, and has produced a valuable book, which should be studied by every student of geography. So much that is written on China is solely political and superficial; but this study strikes down to basic physical conditions, and from position, relief, soil and climate builds up an explanation of Chinese life and activities. Problems of climate and their relation to agriculture are especially well treated. Manchuria and the outer dependencies of China are included. There are numerous clear maps, many excellent illustrations and copious bibliographies. Prof. Cressey has succeeded in writing geography without dullness, and given a survey of lasting value.

Centenary of the Landing of Charles Darwin on the Galapagos Islands

CHARLES DARWIN landed on the Galapagos Islands on September 16, 1835, and spent about five weeks observing and collecting in the archipelago. His observations, especially on the differences presented by the finches and the giant tortoises found on the different islands, provided the basis for the new line of thought which resulted in the hypothesis of the "Origin of Species".

The committee of Section D (Zoology) of the British Association arranged that the centenary of his landing should be commemorated by a series of communications occupying the afternoon meeting at Norwich on September 6.

Sir Edward Poulton, in an opening address, reminded the audience that Darwin sailed in the *Beagle* in December, 1831, when he was not yet twenty-three years of age. Nearly four years later the ship reached the Galapagos Islands, and Darwin observed how every kind of animal, and particularly the finches and the giant tortoises, on each island differed slightly from those on the other islands. He realised that these observations, if well founded, "would undermine the stability of species"; that, in fact, he must abandon the idea of the separate creation of species, though he was entirely unable to account for their origin. The solution of this problem became the great work of his life.

Sir Edward Poulton divided the past century of evolutionary thought into three periods. First came a time of inactivity for nearly everyone except Darwin, who began his first notebook on evolution in 1837. In the following year he read Malthus "On Population", and "in a sudden flash of insight" came the idea of natural selection as the great motive force of evolutionary progress, and on this he worked and pondered for twenty years. The second period opened in June 1858, when Darwin received Wallace's letter and manuscript, written at Ternate, in the Moluccas, which showed that Wallace had reached an identical position. Their views were placed before the Linnean Society on July 8, and Darwin's "Origin of Species" was published in the following year. The third period began with the rediscovery in 1900 of the work of Mendel, at first supposed by many to be opposed to Darwinism, but which threw new light on inheritance, led to many new facts consistent with natural selection and solved the difficulty, which Darwin had felt to be the greatest of all—the supposed "swamping effect of intercrossing". Sir Edward Poulton reaffirmed his strong belief in the value of the theory of natural selection.

Prof. J. H. Ashworth gave an account of Charles Darwin as a student in Edinburgh from October, 1825 until April, 1827. The sources of information on this period were the minute book of the Plinian Society of Natural History of the University of Edinburgh, of which Darwin was a member during his second academic session, and a notebook begun by Darwin in March, 1827. The minute book is of interest as showing the range of subjects discussed in the students' natural history society in Edinburgh one hundred years ago, and as containing the record of Darwin's presentation to the Society on March 27, 1827 of his original observations on the 'ova', which were in fact larvae, of the polyzoan *Flustra* and on the 'ovum' or egg-case of the marine leech *Pontobdella muricata*. Darwin's observations on these two subjects occupy four and a half pages in his notebook, which also contains notes on other marine animals, which he collected in the Firth of Forth and examined in Edinburgh.

Prof. Ashworth referred to other papers found among Darwin's Edinburgh notes, and to a few of Darwin's friends, of whom the most important were Robert Grant, a very energetic collector and investigator of sponges and other marine invertebrates, who left Edinburgh in 1827 to be the first professor of zoology in University College, London, and William Macgillivray, then assistant keeper of the Natural History Museum of the University of Edinburgh, who was well known for his special knowledge of birds. Prof. Ashworth concluded that in Edinburgh Darwin laid the foundation of his knowledge of the science of natural history.

Prof. G. D. Hale Carpenter, who was asked to speak on Darwin and entomology, pointed out that Darwin's early interest in entomology was overshadowed in later years as other subjects became more absorbing. He proceeded to refer to one aspect of entomology which has been much aided by the principle of natural selection, namely, the study of the coloration of insects. Prof. Carpenter held that concealing coloration, warning coloration and mimicry could all be accounted for by natural selection, and not by any other explanation which has yet been brought forward. Before Darwin's day, conspicuousness could not be satisfactorily explained except by appeals to anthropocentric ideas or terminology.

Prof. E. W. MacBride said that if Darwin had produced no other book than his journal of researches during the voyage round the world of H.M.S. *Beagle*, he would have shown himself to be one of the finest naturalists that ever lived, and his description in this work of the Galapagos Islands and of their fauna is a most masterly production. Prof. MacBride proceeded to refer to the giant tortoises, the lizards and the birds, and said that Darwin was at an utter loss to account for the prodigality of creative power which had resulted in the different islands having distinct species of tortoises and birds. Later Darwin applied his theory of natural selection to the explanation of the occurrence of the variety of species in the different islands. Prof. MacBride expressed his strong dissent from this explanation and from Sir Edward Poulton's views, and concluded by stating that in his opinion the ultimate cause of difference in species is difference in habits and in reaction.

Mr. H. W. Parker recalled Darwin's statement that the reptiles of the Galapagos gave "the most striking character to the zoology of these islands". During the last century, the number of species of reptiles was found to be greater than Darwin had realised, but the increased knowledge emphasises what he considered "by far the most remarkable feature in the natural history of this archipelago—that the different islands to a considerable extent are inhabited by a different set of beings". Mr. Parker, in giving an account of the present distribution of the reptiles in the islands, stated that of the fourteen species of giant tortoises, three are probably extinct and most of the others exceedingly rare. The curious marine lizards (*Amblyrhynchus*) and the land lizards (*Conolophus*) are also in grave danger of extermination. Man has been the principal destructive agent in the past, but the future of all species, large and small, is jeopardised by the presence on the islands of introduced pigs, dogs, rats and cats which have run wild. That the remnants of the fauna are in imminent danger has been realised by the Government of Ecuador, which has passed decrees proclaiming certain of the islands as 'asilos reservados', and also giving protection to all the interesting indigenous species throughout the archipelago. Mr. Parker urged that only international co-operation could make this legislation effective, and that the British Association should initiate action to this end.

An Early Stone Age Culture of America

REFERENCE to the discovery of 'Folsom points' and to 'Folsom man' in the archæological literature of the United States from time to time within the last decade has given rise to an expectation that it might be possible, within a comparatively short time, to construct some sure and certain foundation for the claim to a relatively high antiquity for early man in America, which has often been advanced, but never satisfactorily substantiated. Since the Folsom point was first recognised in 1927 as an early and specific stone age industry of North America, occurring on occasion in association with a presumedly early fauna, later discoveries and further study of its characteristics and distribution have given clearer definition to the archæological problem and indicated the direction of intensive search for the geological and palæontological data upon which the solution of the chronological problem ultimately will depend.

Passing reference has been made in the columns of NATURE from time to time to the discovery of evidence relating to Folsom man. Such evidence was by no means always such as to carry conviction, nor did it give, although the 'point' itself is sufficiently characteristic, any clear impression of a specific cultural phase. Such uncertainties, however, are now to a great extent removed by the recent examination and partial excavation by Frank H. H. Roberts, Jr., archæologist of the Bureau of American Ethnology, of a Folsom midden in a locality now particularised as the Lindenmeier Site, twenty-eight miles north of Fort Collins, in northern Colorado. His report* has not only made important and substantial additions to knowledge of the Folsom culture and technique, but it has also crystallised previous evidence and affords opportunity for review of the data relating to the Folsom culture as a whole.

It may not be out of place to point out that, while it is now possible, thanks to Mr. Roberts's new evidence, to form a fairly clear conception of the Folsom phase of culture, Folsom man is unknown. No human skeletal remains have been discovered in association with Folsom artefacts as yet.

In the light of the evidence from the Lindenmeier Site, as will appear later, there is now justification

* "A Folsom Complex: Preliminary Report on Investigations at the Lindenmeier Site in Northern Colorado". *Smithsonian Misc. Collect.*, 94, No. 4.

for speaking of a 'Folsom culture' of which the existence previously had been a matter of inference only, from the type of a single class of implement, and of which the picture even yet is not complete in detail. It is the culture of a hunting people closely associated with the bison. A concurrence of evidence, geological, palæontological and archæological, points to the conclusion that not only does it represent an earlier phase in the American cultural sequence than that of the 'Basket-Makers' of the Pueblo area, hitherto regarded as the earliest to appear in the south-west, but also that in the instance of the Folsom implements a case for a quaternary dating has been made out with a closer approach to certainty than in any other culture of the American stone age.

The Folsom point, the characteristic implement of the culture, is of a triangular, or rather leaf-shape, in which the greatest breadth lies between the tip and the middle point of the blade. In size, it varies from 17 mm. to 75 mm. in length, 14 mm. to 32·5 mm. in breadth and 3 mm. to 6 mm. in thickness. A variant form has rather a wider range in size. The material is varied, chalcedony, jasper, chert, quartzite, petrified wood, moss agate, geyserite (rare) and white sandstone, all being recorded.

The indigenous inhabitants of North America have always been essentially a stone-using people. Even the native copper area of Lake Superior developed a chalcolithic rather than a true metal culture. Within living memory, stone implements continued to be made in California in full view of the railway track. In the course of their long history of stone using, the Indians developed many eccentric forms of implement, for which anthropologists, in default of a better understanding, have been content perforce to accept the designation 'ceremonial'; but of all the implements fashioned for practical use, probably none is more distinctive than the 'Folsom point'. Its peculiar characteristic is a longitudinal groove, or channel, running down the middle of the blade, which leaves a ridge on each side parallel with the edge. As the two faces of the typical implement are identical in form, this gives it in section the shape of a double concave. The sides are prolonged at the base to form wings, making the base a semi-circular gap or notch.

The form of the point, obviously the tip of a projectile weapon, either arrow or spear, made it peculiarly liable to fracture. The vast majority of the implements of this type which have been found are broken, only the tip or the butt-end being found. The predominance of the butt-end on the Lindenmeier Site no doubt was due, as Mr. Roberts has suggested, to a practice of retrieving the shaft of the weapon and bringing it back to camp to fit a new point. The purpose of the remarkable channel is unknown, although the groove in the modern bayonet at once suggests an analogy.

A brief reference to the course of research which has led up to Mr. Roberts's investigation, will not be out of place, especially as, in so far as it relates to the question of distribution, it has a bearing on the interpretation of the evidence relating to the Folsom culture which needs further elucidation.

As already mentioned, the specific character of the Folsom point was established in 1927. Before that date, and indeed so far back as 1897, the peculiar features of the implement had been noted; but as the specimens were mostly surface finds, their significance had not been appreciated. In 1925, the attention of J. D. Figgins, director of the Colorado Museum of Natural History, was directed to a bone deposit on the upper sources of the Cimmaron River near Folsom, New Mexico. Investigations in the following year brought to light evidence which seemed to demonstrate beyond question the definite association of stone artefacts and an extinct bison. Additional 'points' were found in 1927 by investigators working on behalf of the Colorado Museum, and Dr. Barnum Brown of the American Museum of Natural History found one specimen still embedded in the matrix between two of the ribs of an animal skeleton, where it still remains on exhibition in the Colorado Museum. It was seen *in situ* by Dr. A. V. Kidder, as well as by Mr. Roberts. It was then agreed that not only could the association not be questioned, but also that the points were totally different from the ordinary types of stone implement hitherto found in the south-west.

In the following year (1928), joint operations by the American Museum of Natural History and the Colorado Museum under Dr. Barnum Brown and Dr. Clark Wissler were made the occasion of an informal conference of geologists, palæontologists and archæologists, who arrived at the generally accepted conclusion that the Folsom find indicated an earlier appearance for man in the south-west than had hitherto been allowed. It was under date of this year that the first account of the Folsom point appeared in Europe in an article by E. B. Renaud on the antiquity of man in North America in *L'Anthropologie*, 38, 23–49.

Of later activity in the study of the problem and search for further evidence, mention may be made of the work in New Mexico of E. B. Howard, of the Pennsylvania University Museum, and of Prof. E. B. Renaud, of the University of Denver, and his students in their archæological survey of Colorado and Nebraska. The former has found in a cave in the Guadalupe Mountains in the south-eastern part of New Mexico a Folsom point in conjunction with musk ox and an animal of the

musk ox group. These occurred in a stratum underlying a level containing Basket Maker material. This find thus established definitely the priority of the Folsom culture. At the same time, the musk ox being a cold-climate animal, it is generally considered to be evidence of the contemporaneity of Folsom man with an Ice Age fauna. Further investigations by Mr. Howard near Clovis, New Mexico, also point to the coexistence of Folsom man and an extinct fauna; but here the evidence is considered open to question, and until it has been published in fuller detail, must be regarded as still *sub judice*.

On the general question of the quaternary age of the Folsom implements and the associated extinct fauna, opinion is at present divided. While some would see in this association evidence for the existence of man in America in late Pleistocene times, others maintain that it points rather to a late survival of Ice-Age animals into recent periods, and that there is no evidence that man was actually present in America in the Ice Age.

Of Prof. Renaud's investigations, what must be regarded as the most important outcome to date is a distinction in the character of the culture which he recently claims to have established. This differentiates the Yuma point from the Folsom point. The former, on the basis of typology, he considers to be older than the Folsom. The two occur in association on many sites as surface finds, and their relative antiquity is still under discussion.

We may now turn to Mr. Roberts's investigations on the Lindenmeier Site, which must be regarded as one of the most important contributions of recent years to prehistoric archæology in America.

The Lindenmeier Site was first discovered by Judge C. C. Coffin and his son, A. L. Coffin, in 1924. From it they collected some 83 points or portions of points, as well as about the same number of other artefacts. They were not, however, then aware of the significance of the former; and it was not until 1930 that they were informed by Prof. E. B. Renaud that they were Folsom points. Further surface finds were made afterwards; but it was only in 1934, when the site was examined by Mr. Roberts, that any intensive investigation was attempted. The finds by members of the Coffin family had been made in a restricted area, some 70 yards by 150 yards in extent; but the point at which Mr. Roberts's excavations were carried out lies apart from this area, and is situated in the side of a ravine or gully about a quarter of a mile away. Here an undisturbed and intact layer of midden material was found at about 14 ft. below present ground-level and about 12 ft. above the bed of the gully. This was partially excavated in October and part of November, 1934; and it is hoped to carry the work further on a future occasion. The midden lies at the deepest point of an implementiferous area lying between the edge of the gully and a terrace, and covering ground approximately 250 yards by 200 yards. The objects of bone and stone are found just above a clay stratum in a layer six inches to one foot in thickness. Except at the midden, where was the main concentration of archæological material, finds over this area are in the nature of chance accumulations.

Of the actual finds, the Folsom points both whole and fractured, as well as flakes and specimens spoiled in making, have afforded Mr. Roberts material for pertinent suggestions as to the obscure technique of manufacture upon which it is not possible to touch here. A large proportion of the other artefacts are scrapers, of which there are several varieties. Some show minute and careful chipping, others are rough and crude. Most belong to the curved end, or 'thumb-nail' type. Of the side-scrapers some are almost paper-like in their thinness. While there is no definite knowledge as to the uses to which some of these scrapers, such as the turtleback and the side scraper, were put, they would serve for dressing skins as well as for knives, gouges, adzes or abrading tools. One of the most interesting types is a graver, an implement familiar in European archæology; but no other evidence is to hand of the practice of the graver's art by Folsom man. Most of these gravers are fortuitous flakes, which have been modified by chipping a small sharp point on one side or end. Some, however, are more definitely shaped. A number of specimens among the implements are classified as knives. The best are carefully chipped blades, which exhibit typical Folsom characteristics in their fluted faces and the marginal retouch. Several of them are made from the channel flakes resulting from the manufacture of points. Among other implements are blades and choppers. Miscellaneous objects include pieces of sandstone showing signs of use—there is no material of this character in the neighbourhood—pieces of hæmatite, smooth and striated from rubbing (a good indication that they supplied pigment material) nodules with battered ends (no doubt hammers) and a number of fragments of bone, which had served as tools.

Most of the bone material was scrappy. Bison, fox, rabbit and wolf have been identified. It is noted as a matter of considerable interest that the bison is identical with the two extinct forms found at Folsom, *Stelabison occidentalis taylori* and *Bison oliverhayi*.

It will be seen that the excavations which have been carried out by Mr. Roberts on the Lindenmeier Site have extended very considerably knowledge of this stone-using, hunting culture, in which

future excavation may well fill in further detail. One point remains to be mentioned. On determination of the specific character of the Folsom point and the advancement of its claim to a high antiquity, attention was directed, as already mentioned, to the fact that it was already known, in one instance at least, having received the name of the "Seneca River point". It was shown to have a wide distribution—from southern Canada to the Gulf of Mexico and from the Rockies to the Atlantic. Further study, however, has demonstrated that the true Folsom points are confined to the High Plains on the eastern slope of the Rockies, while the more widely distributed point is a larger, more generalised form, centring notably in the Finger Lakes section of New York State, in Ohio, Tennessee and southern Virginia. The affiliation and the chronological and distributional relation of the two forms are problems which are now being made the subject of study by Mr. Roberts.

Until the typological and chronological relations of the two forms of point are established with some degree of precision, no finality in the interpretation of the archæological evidence is attainable. Tentatively, however, it may be pointed out that the evident antiquity and the known distribution of the true Folsom point are consistent with the view that it is a specialised form developed by the people who, it has been suggested, penetrated to the south-west in the period of transition at the close of the Ice Age along a corridor on the eastern slopes of the Rockies. It will be interesting to see if the researches in Siberian archæology, upon which Mr. E. B. Howard is to engage, produce any typological evidence of an Asiatic ancestry for this remarkable American type of implement.

The Percy Sladen Expedition to Lake Huleh

HULEH is a shallow lake lying in the northern end of the Jordan Valley, where it extends towards Mount Hermon. The sides of this valley are formed here by two parallel ranges of mountains, but at the south end of the lake the valley is closed by low hills except where the Jordan has cut a deep gorge into Lake Tiberias, the fall to which is 600 feet. The actual lake is approximately five miles long by three across, and is roughly pear-shaped, with its broad end to the north. Its maximal depths are 10–12 feet, but its greater part is not more than 4–5 feet. On its east side the mountains, which are basaltic, commence their rise close to the lake, and the shore is rocky, much large material being carried down the numerous water-courses. On the west side, a broad plain extends out from the lake, for the strong winter torrents have brought down quantities of gravel, which form spits projecting into the lake. Over most of the central area, the bottom of the lake is of soft grey mud, which is largely populated by plants of *Potamogeton*. At the extreme south, there is a small area where *Phragmites* dominates, and this also grows on the eastern side in isolated patches. On both sides of the lake there are numerous springs, and some cold patches in the lake are supposed to mark further effluents.

The lake is bounded on its northern side by a large swamp, through which the Jordan flows as a swift stream, even in the dry season. The swamp begins as a band of floating lilies (*Nuphar*) across its north end, extending down each side for half a mile. On the inside of the lilies, the plant succession is at present being studied. The swamp is not homogeneous in structure, and its most striking feature is the papyrus, which over large areas is the dominant plant form. Through it, progression is only possible along waterways, which are kept open by the Arabs, who use it for many purposes. The swamp consists of a mass of roots, much matted and bound together with plant debris in various stages of decomposition. The roots appear to be floating in the water, and it is easy to sink waist deep through masses of debris, where the papyrus is not too thick. At various places clear pools are found, these apparently due to springs. At the sides of the swamp the land is being reclaimed by Arabs for the planting of maize and millet.

The channel of the Jordan runs down the middle of the northern swamp, where heavier silt has been deposited during the floods of the rainy season. Local observations suggest that the swamp is extending southwards and encroaching on the lake, almost as if pushed by the processes of reclamation on its shores. One of the most striking features of the lake is the large quantity of fine silt brought down by the Jordan, when irrigation is occurring further up the valley. It is of a light grey colour, and quite different from the mud formed by plant decomposition. It is deposited generally over the lake, and forms in addition a broad bar across its northern end.

The rights over the lake have recently been purchased by the Palestine Land Development Co. from the Arab owners. The company has employed engineers to estimate the cost of the drainage of the lake and swamp, and is now selling it upon these estimates. Several interested companies are employing their own engineers to check these. Up to the present, no work has been commenced, but it is anticipated that the drainage, which is a simple question, will be completed in 1936 or the following year.

The biological survey of Lake Huleh is in charge of Mr. Roger Washbourn with a botanist, both from the University of Birmingham. The lake is interesting mainly in comparison with Lake Tiberias and other parts of the Rift Valley in Palestine and East Africa. The presence of animals of African affinity was shown by Annandale in 1916, and the biologists are largely concerned with investigating the fauna and flora before the lake ceases to exist. In addition, Huleh lies near the southern boundary of several palæarctic species. The ecology also of a lake with a papyrus swamp in this latitude should prove interesting. Having these objects in view, the zoological part of the work is largely the collection of animals from the varied habitats that the lake and swamp present. To define these accurately, the physical and chemical conditions are being studied, and these are, of course, a prime factor in governing the plankton. The botanist is fully occupied with his study of the swamp and the interrelations of the plants in their different habitats. The difficulty of transport is considerable—and the lake is fever-stricken—but it is hoped that an impression will be secured of the plant and animal life of an area which will soon have ceased to exist.

The Chemotherapy of Malaria*

QUININE was discovered by Pelletier and Caventou in 1820 and was promptly manufactured in France and England in quantities sufficient to permit of its use in the treatment of malaria, in place of crude cinchona bark. This was an early and unconscious application of the principle upon which Ehrlich was to found chemotherapy ninety years later. By that time, thanks to the labours of Hesse, Skraup, Köenigs, von Miller and Rohde and Rabe, constitutional formulæ had been assigned to quinine and the other cinchona alkaloids, which Rabe and his collaborators confirmed in a series of researches culminating in the complete synthesis of dihydroquinine and dihydroquinidine in 1931. Partial syntheses had been effected some years earlier and the methods employed had been extended to the preparation of products allied to the cinchona alkaloids in type, but of simpler structure. In 1891 Grimaux and Arnaud prepared from cupreine a series of homologues of quinine, one of which, ethylcupreine, was tried clinically and found to be somewhat more active than quinine, and this first French experiment in the production of 'modified cinchona alkaloids' led to the preparation of many other substances of this type.

Chemists had in fact accumulated a mass of possible anti-malarials, the therapeutic value of which there was no practical means of testing. This want was supplied when Roehl devised his technique of testing such drugs in bird malaria, using canaries for this purpose. Of the various 'leads' then available for the synthesis of new anti-malarials, Prof. Schulemann and his co-workers, Schönhöfer and Wingler, selected methylene blue, which had been shown to have some action in malaria, and from this starting point they evolved plasmoquine in 1924. This was followed by atebrin, discovered by Mauss and Mietzsch in 1930.

These two drugs have one feature in common, a dialkylaminoalkylamino-side-chain, $-NH-CHMe-CH_2-CH_2-CH_2-NEt_2$, attached at position 8 in 6-methoxyquinoline, in the case of plasmoquine, and at position 5 in 2-chloro-7-methoxyacridine, in the case of atebrin; but as acridine is quinoline with a benzene ring fused on, both drugs can be regarded as derived from 6-methoxyquinoline, a characteristic they share with quinine, which, however, has a different and more complex side-chain. Plasmoquine acts preferentially on the sexual forms (crescents or gametocytes) and atebrin and quinine on the asexual forms (schizonts) of the malaria parasite. Their respective actions in the various types of malaria is not as clear-cut as this brief description implies, but it is permissible now to divide anti-malarial drugs into 'anti-gametocyte', represented by plasmoquine and its allies, and 'anti-schizont', of which quinine and atebrin are types.

These discoveries have led to great activity in the synthesis of such drugs in Great Britain, France, Russia and elsewhere, and Prof. Robinson gave an account of the reactions used in the

* Based on a discussion, introduced by Col. S. P. James, in Section B (Chemistry) of the British Association meeting at Norwich on September 9. Other contributors to the discussion were Prof. W. Schulemann, Prof. R. Robinson, Dr. P. Tate (with Prof. Keilin and Miss M. Vincent), Dr. T. A. Henry, Sir Rickard Christophers and Prof. Warrington Yorke.

preparation of the extensive series of potential anti-malarials made in his laboratory. One of these, in which the side-chain of plasmoquine is replaced by $-NH-CH_2-CH_2-CH_2-NH-CH_2-CH_2-CH_2-NH_2$, was found to have a chemotherapeutic index 1 : 62 against 1 : 32 for plasmoquine and is, therefore, a promising material for clinical trial. The necessary bird malaria tests on these substances are being made in Prof. Keilin's laboratory at Cambridge by Dr. Tate and Miss Vincent, and the former described the methods used. Inoculation of infected blood provides material for tests on asexual forms of the parasite, and birds infected by bites from mosquitoes are used for tests of activity against gametocytes and sporozoites, and details were given of the results of such investigations of a number of Prof. Robinson's substances.

The bird malaria test has also been applied to a number of other problems. Drs. Buttle and Trevan have shown that the interesting series of alkaloids isolated by Messrs. Goodson and Sharp from ten species of *Alstonia* have no action in bird malaria, and the same is true of the alkaloids of *Picralima klaineana*, though both these drugs have some repute in various tropical countries as remedies for malaria. The same workers made a comparative examination of specially purified specimens of the principal cinchona alkaloids and found that, as an anti-schizont drug in bird malaria, quinine was about twice as active as quinidine or cinchonidine, and possibly five times as active as cinchonine.

These results are of considerable interest in connexion with the use of mixtures of cinchona alkaloids as a cheap substitute for quinine, and justify the action of the Malaria Commission of the League of Nations in providing a standard for such mixtures, which prescribes a minimum content of fifteen per cent of quinine. Much work has also been done, particularly by Giemsa, in assessing the therapeutic value in bird malaria of 'modified cinchona alkaloids'. The results show that, so far, no product of this type is much better than quinine or dihydroquinine; but this work has provided a fund of information as to the influence on anti-malarial activity of modifications in the structure of drugs, which will probably be of great value in the biochemical and biophysical investigations, which are beginning to be made in the hope of ascertaining how and why such drugs exert their specific action. As an example of such work, mention may be made of the paper by Sir Rickard Christophers describing the methods he has used, and some of the results obtained in examining the view that chemotherapeutic effect is a result of some kind of combination between protein substance and the basic side-chains, which are a characteristic feature of effective anti-malarial drugs.

It was particularly appropriate that the discussion should be introduced by Col. James, who has had special opportunities for clinical investigation of the new drugs, plasmoquine and atebrin. He provided a careful survey of their value as true causal prophylactics, as means of avoiding relapses and as preventives of spread of the disease, these being the principal characteristics of their action in which they surpass quinine, for they are to be regarded, not as substitutes for this alkaloid, but as additional weapons in anti-malarial campaigns.

Col. James finally expressed the hope that provision would be made in Great Britain for more intensive chemotherapeutical research. On the same point, Prof. Robinson emphasised the need for the closest co-operation between chemists and biologists in work of this kind, and Prof. Warrington Yorke pointed out that, although in a number of cases, such as sleeping sickness and amœbic dysentery, the first useful chemotherapeutical observation had been made by English workers, we had failed to follow up these observations by systematic pharmacological and chemical work, with the result that the countries of the Empire still had to depend largely on imported synthetic drugs.

T. A. H.

Obituary

Mr. J. F. Herd

JAMES FLEMING HERD, senior scientific officer in the Radio Department of the National Physical Laboratory, died on July 22 at the early age of forty-seven years.

Born and educated in Dundee, Herd entered the Post Office, and became a highly skilled officer of the telegraph service. He served in the Royal Flying Corps and Royal Air Force, as an instructor in that part of the service which developed into the Wireless and Electrical School. Retaining the rank of flight lieutenant in the R.A.F. Reserve of Officers, he joined the Meteorological Office as a senior professional assistant, for service at Meteorological Office Radio Station, Aldershot, then engaged in a study of atmospherics in relation to thunderstorm detection. On the formation of the Radio Research Board, that station was taken over by the Department of Scientific and Industrial Research, to which its two scientific officers were seconded, later to become substantive

members of the Department's staff. In the steady growth of the Department's organisation for radio research, he took a rapidly increasing load of responsibility, and the formation of the Radio Department, National Physical Laboratory, in 1933 brought him to the rank of senior scientific officer as officer-in-charge of the Slough Division of the new entity, and as secretary of a number of committees of the Radio Research Board.

Herd's published scientific work falls far short of representing his notable contributions to the progress of fundamental radio research. He submerged his individual interests in the development of that team-working which the Slough Station chose as its method of attack on the complex and varied problems in the pathology of radio communications entrusted to it for study. His contributions to the *Proceedings of the Royal Society*, the *Journal of the Institution of Electrical Engineers* and other papers, and his monograph (jointly with two departmental colleagues) on "The Cathode Ray Oscillograph in Radio Research" give some evidence of his rare gifts as an investigator. His gifts for scientific organisation did much towards the success of the London (1934) meeting of the Union Radio-Scientifique Internationale, in which he took an important part.

Dr. F. C. Shrubsall

DR. FRANK CHARLES SHRUBSALL died at his home in Hampstead on September 25, aged sixty-one years.

He was the only child of a master mariner. Never robust, his health during childhood gave anxiety to his family, and he was taken on several sea voyages. Thus, early in life he came in contact with differing types of men, and this aroused in him that intense interest in the study of mankind which was to shape his whole career.

Shrubsall was educated at Merchant Taylors' School and went up to Clare College, Cambridge, in 1892 with an entrance scholarship. He graduated in 1895 taking first class in the Natural Sciences tripos. He entered St. Bartholomew's Hospital and qualified in medicine in 1900 after a brilliant career as a student. Appointments at St. Bartholomew's and the Brompton Hospital for Chest Diseases gave him much experience in the practice of medicine, and intensified his interest in the study of human types. He proceeded to his M.A. degree at Cambridge in 1899 and took the M.D. in 1903. His remarkable clinical gifts were speedily recognised; he was appointed in 1908 to a Hunterian professorship at the Royal College of Surgeons and elected to the fellowship of the Royal College of Physicians in 1912.

When the British Association met in Cambridge in 1904, Shrubsall read a paper in Section H (Anthropology) on the influence of selection by disease on the constitution of city populations. This paper at once established his position among British anthropologists. He became a secretary of Section H and for eighteen years continued to hold this onerous post. During this period, he contributed many articles to the Section of original and important character and did an immense amount of work on research committees.

The opportunities for continued research held out by the work of the school medical service attracted him, and in January 1909 he was induced to enter the service of the London County Council. Here he found immediate work to hand in the collating and analysis of an immense amount of raw material in the shape of physical measurements which had been collected. As the result of the growth of the work of the school medical service, Shrubsall found himself in 1912 attached to the headquarters staff in charge of the special school division. Thus began his association with problems of mental deficiency and juvenile delinquency, matters in which he was destined to become acknowledged the foremost expert in the country. Increasing pressure of public work compelled him to relinquish his secretaryship of Section H in 1923, and he was elected president of the Section for the Toronto meeting in 1924. He took as the subject of his presidential address "Health and Physique Throughout the Ages".

At the time of his death, Shrubsall was a senior medical officer of the London County Council in charge of a section which included special and reformatory schools, mental deficiency, care of the blind, and medical examination of employees.

The value of Shrubsall's services to British anthropology and of his pioneer work in the sphere of public health, particularly that associated with the elucidation of the problems of mental deficiency and juvenile delinquency, cannot be too highly estimated. He was a man of great generosity and kindness of character, and was greatly beloved by all his co-workers in every sphere. C. J. T.

WE regret to announce the recent death of Baron Léon Frédéricq, emeritus professor of physiology at the University of Liège, at the age of eighty-four years. He was born in 1851 at Ghent, where he became doctor in natural science and medicine in 1871. After studying experimental methods in several foreign laboratories he became assistant in the Department of Physiology and Comparative Anatomy at the University of Ghent, where he carried out investigations on the presence of fibrinogen in the blood plasma. In 1879 he succeeded Theodor Schwann at Liège in the chair of physiology, which he held for more than forty years, during which he carried out important researches on the physiology of circulation, respiration and the nervous system. He was the author of a standard treatise on physiology and a handbook of technique and demonstrations in general and special physiology. At the beginning of the century he was the co-founder with Paul Héger of the *Archives internationales de physiologie*. He also founded a biological station for botanists and zoologists. Frédéricq was a corresponding member of the Institut de France, commander of the Legion of Honour and of the Crown of Italy and fellow of the Physiological Society of London, in addition to many other distinctions.

News and Views

Sir John Flett and the Geological Survey

ON October 1 Sir John Flett retired from the directorship of the Geological Survey and Museum. He joined the Survey in 1901, in 1903 he was appointed petrographer, and in 1911 he succeeded Dr. John Horne as assistant director for Scotland. On the retirement of Sir Aubrey Strahan in 1920, he was made director. He took over his new duties at a moment when several important changes had been introduced; the Committee of Advice on the Geological Survey, which had reported to the Board of Education since Sir Jethro Teall's induction to office, now gave place to the Geological Survey Board, reporting to the Lords of the Committee of the Privy Council for Scientific and Industrial Research; at the same time there was a considerable increase in the scientific staff. With characteristic energy, Sir John Flett began at once to make full use of the improved conditions: one of the first steps was the establishment of three branch offices in coal-field centres, which proved of great value in permitting closer contacts with the industry.

DURING Sir John Flett's directorship, not only has steady progress been made with the primary 6-inch survey, the re-survey of economically important areas, and the provision of colour-printed 1-inch maps, but also there has been marked improvement in the production and style of reproduction, both of maps and memoirs. Other departments of the Survey's activity—the investigation of underground water supplies, recording of boreholes, photography of geological subjects for educational and record purposes, the study of geophysical methods of surveying—have been vigorously stimulated, and useful collaboration has been set up with other bodies in relation to research upon soils, coal and building stones. Sir John's single-minded devotion to the work of the Survey and Museum and to the needs of the public, backed by a keen and able staff, achieved a fitting culmination with the opening of the new Museum of Practical Geology and Survey offices in South Kensington last July.

As recorded in NATURE of July 20, p. 96, Dr. Bernard Smith has been appointed to succeed Sir John Flett as director of the Geological Survey of Great Britain. It is now announced that Mr. Henry Dewey has been appointed to succeed Dr. Bernard Smith as assistant director (England and Wales). Mr. C. E. N. Bromehead, district geologist in York, will shortly take charge of the London District, now vacated by Mr. Dewey. Mr. T. H. Whitehead has been promoted district geologist, and will take over the Survey Office in York upon Mr. Bromehead's withdrawal to London. Dr. J. Phemister has been appointed petrographer in succession to the late Dr. H. H. Thomas.

Faraday's Eyesight and the Blind Spot

UNDER the heading "Science News a Century Ago" a paragraph headed "Faraday's Eyesight" appeared in NATURE of January 12, p. 77. The note referred to an entry in Faraday's "Diary" of date January 15, 1835, in which Faraday stated he had noticed "a slight obscurity of the sight of my left eye". Dr. Frank Marsh, writing from the Pathological Laboratory, c/o Anglo-Iranian Oil Co., Ltd., Masjid-i-Sulieman, via Ahwaz, South Iran, suggests that the quotation in NATURE indicates that "Faraday had discovered his 'blind spot', that is, the optic disc, the place of exit of the optic fibres from the retina, which exists in the retina of every normal person". We have consulted a leading authority on ophthalmology upon Dr. Marsh's suggestion, but he thinks that the explanation of the blur in Faraday's vision as being due to his blind spot is not satisfactory for several reasons. Faraday describes it as a "slight obscurity of the sight", that is, it was a definite blur—in ophthalmological phrase, a *positive* scotoma. The blind spot causes a hiatus in vision, but no positive blur; in other words, causes a *negative* scotoma. Apparently the blur was first noticed when Faraday used both eyes in reading, though it is not definitely stated that the right eye was open. If both eyes were being used, the blind spot would not be noticed in reading. Moreover, the size of the scotoma ("about half an inch in diameter") does not correspond with the visual angle subtended at the nodal point of the eye by the normal blind spot. Faraday's description is meticulously accurate, as one would expect from him, and it is unlikely that he would write "to the right and below the axis of the eye" if the true projection were to the left, as would be the case for the blind spot. It is probable that Faraday had a temporary retinal lesion, possibly a small retinal hæmorrhage, and that this accounted for the obscurity he described. In concluding his letter, Dr. Marsh asks whether Faraday's entry was "the earliest reference to observations on the physiological 'blind spot'". It was certainly not; for in the second volume of the *Philosophical Transactions* it is recorded that Mariotte demonstrated the blind spot to the Royal Society before King Charles II in 1668.

A Science News Service in London

OF recent years the desirability of establishing a closer relationship than exists at present between the very different realms of science and the newspaper press has been realised by an increasing number of leaders in both; and a year ago attention was again directed to the movement towards a British Science News Service by Sir Richard Gregory, who made "Science in the Public Press" the subject of his presidential address to the Association of Special Libraries and Information Bureaux. The formation

of a British Science Service, either as an independent venture or as a London bureau of Science Service of the United States, had long been desired by the director of Science Service, Mr. Watson Davis, and after a necessary period of preliminary discussion and experiment an organisation in the second form has recently been opened at 102–5 Shoe Lane, London, E.C.4, under the direction of Mr. Donald Caley. About twenty representatives of different departments of pure and applied science, including Sir F. G. Hopkins, president of the Royal Society, have consented individually to act in consultative capacities in connexion with this London organisation. The co-operation of scientific workers with the new venture is invited, by supplying information relating to researches on which they are engaged (such information to be treated as confidential when and for as long as desired); sending advance proofs of original communications to scientific journals which they edit or control, or regular copies of the journals, which will invariably be mentioned in newspaper summaries; and to make to Mr. Donald Caley any suggestions which may help him to increase the scope and usefulness of the organisation.

Cultural History in Nebraska

IN another column of this issue (see p. 555) there appears a brief summary of certain conclusions as to cultural sequences in Nebraska, United States, which have emerged as a result of a review of the archæology of that State by Mr. W. D. Strong. It does less than justice to a record of remarkable interest. Among the numerous investigations of recent date, to which Mr. Strong refers, is that of Signal Butte, a stratified site examined by himself, on which evidence of three distinct cultures is to be observed. The levels in which these are found are separated from one another by deposits of Æolian origin, the whole series being superimposed upon sands, which Mr. Strong himself holds to be water-borne and of Pleistocene age. The level of the earliest human occupation is immediately superimposed on these sands. The interpretation of the deposits in terms of climatic variations, based on a correlation with data from other sources, postulates for the whole series, beginning with the period of earliest human occupation, a period of 7,000–10,000 years. Further, this is the only site as yet discovered in America on which stratification gives a clue to the progressive development of type implements of stone in chronological succession. No less interesting and revolutionary in its geographical, archæological and historical implications is a discovery, which hitherto has escaped the attention of archæologists, that while there was a hunting culture on the plains dependent on the bison, in the earliest and in the latest phase of aboriginal existence until it was swept away by Caucasic culture, there intervened between early and recent hunters a semi-horticultural mode of life, akin to that of the Eastern Woodland type, which was forced back to the Missouri with the coming of the horse. This carries with it implications, fully elaborated by Mr. Strong, which necessitate a modification of current views on geographic controls in the Plains area.

Primitive Traits in Amerindian Skulls

IT is now generally accepted that no skeletal remains of the genus *Homo* other than those of 'modern' man have hitherto been found on the American continent. Since the arguments put forward by Ameghino early in the present century in support of the primitive character and high antiquity of the skulls he had found in South America were shown by Dr. Aleš Hrdlička to be untenable, it has been claimed from time to time that human remains exhibiting characters other than those of *Homo sapiens* have been discovered; but invariably closer examination of the evidence has failed to support this interpretation. One of the latest discoveries of this nature is that of a fragment of a skull found by Dr. Earl H. Pell, of the Nebraska University, in a large mound of unknown age near the site of a prehistoric village in Nebraska. The skull was that of a middle age man which showed abnormally highly developed eyebrow ridges, intermediate in degree between Neanderthal man and 'modern' man. On the evidence of these supra-orbital ridges it was at first thought that the skull might be included in the Neanderthal group. It has now been subjected to a close analysis by Dr. Hrdlička, whose decision is not only adverse to any close affinity with Neanderthal man, but definitely rules that it comes within the 'modern' group, on the evidence that in all its characters, excepting the eyebrow ridges, it belongs to the type of the modern Indian. In discussing the skull (*Amer. J. Phys. Anthrop.*, **20**, 2), Dr. Hrdlička goes on to point out that while the high development of these ridges may be regarded as evidence of "an ancestral connection with Neanderthal Man somewhere outside America" it does not show uninterrupted filiation, nor can it serve as an index of antiquity.

Recent Acquisitions at the British Museum, Bloomsbury

AMONG the recent additions of archæological interest, which are described in the *British Museum Quarterly*, **10**, 1, is a striking example of the artistic ability of the early Maya in the form of a cup with painted ornament, which has additional claim to attention in the fact that it comes from so far south as San Salvador. Especially important for students of early Buddhist art in India is a series of stucco figurines, twenty-five pieces in all, of which eighteen are heads, obtained by the French Archæological Delegation in Afghanistan in 1926–28, at Hadda, about five miles south of Jalalabad. In accordance with the policy, foreshadowed at the time of the acquisition of the Eumorfolpoulos collections, of devoting space in the *Quarterly* from time to time to descriptions of especially important examples of the art and culture of the Far East, two notes with illustrations deal respectively with a bronze of the Chou dynasty (1123–249 B.C.) and painted bricks of the succeeding Han dynasty. The bronze bowl or *tui* for holding cereals on ceremonial occasions,

such as the worship of ancestors, is one of the finest of the few which exist outside the Peiping Palace collections, and is otherwise remarkable in that it has four handles. It is highly ornamented with conventionalised designs including elephant heads and, possibly, stylised tigers. It has an inscription of sixty-nine characters, which is perfectly legible, though interpretations vary. The bowl would appear to commemorate a grant of land, for services rendered, to the Marquis Hsing by an emperor, conjecturally identified as Ch'êng (1115–1078 B.C.) The group of three painted bricks form a pediment which comes from a Han tomb. On them is a free and spirited symbolical design which is here interpreted as expressing the form taken by the Taoistic belief in life after death under that dynasty.

The Typhoon of September 21, 1934, in Japan

WHAT is described as the greatest typhoon on record struck the southern coast of Japan early on September 21. A week later, the Earthquake Research Institute sent several of its members to the district, and their reports on various features of the typhoon are included in a special volume of the Institute's *Bulletin* (Suppl. vol. 2, 302 pp. and 34 pls.). All the nine memoirs are written in Japanese, but, with two exceptions (mainly in tabular form), they are followed by summaries in English. The typhoon was generated at sea, in about lat. 11° N., long. 141° E., on September 13. It was then weak, and travelled slowly towards the north-west. A week later, near the Ryukyu Islands, its course changed to north-east. When it reached Sikoku, on the southern coast of Japan, its centre showed a pressure of 22·4 in., probably a record for land stations. The typhoon then passed over the adjoining districts, causing much damage to houses and trees, but it is worthy of notice that some earthquake-proof school buildings withstood a gale of 134 miles an hour. The main damage occurred in the coastal districts, and was due partly to the sea-waves, or kaze-tunami, raised by the typhoon and partly to a sudden rise of the sea that at Osaka ranged from 9·5 to 18·7 ft., and at Kobe from 5·8 to 6·5 ft. Among the causes of this abnormal rise, Mr. R. Takahasi includes a suction-like action on the sea-water due to the low pressure in the centre of the typhoon-path and the drift of the water to the coast by the force of the winds. Farther on, the typhoon passed over Lake Biwa, generating seiches with amplitudes of 10 in. and a rise of the same amount in the northern half of the lake, due again to the drift of the water. Even in the neighbourhood of Tokyo, the sea-level rose by about 4 ft.

British Association Seismological Committee

DURING the past year, the Committee has lost two of its members, Sir Horace Lamb and Prof. H. M. Macdonald. Two former members, Sir Alfred Ewing and Sir Arthur Schuster, also died since the last report was issued. The year has been marked by the publication of some important memoirs by members of the Committee. Two of them are on microseisms by Mr. A. W. Lee, who has shown that the average amplitudes of the east and vertical components of the microseisms recorded at Kew in 1932 were equal, and that microseisms usually approach England from the north-west, and are associated with storms in the Atlantic. A valuable memoir on the times of transmission of earthquake waves by Dr. H. Jeffreys and Mr. K. E. Bullen has been published by the International Seismological Association (*Trav. Scie.*, Sec. A, Fasc. 11; 1935), the inclusion of the summaries for individual earthquakes having been rendered possible by a grant from the Gray-Milne fund. A new catalogue of earthquakes, for the years 1925–30, has been prepared by Miss E. F. Bellamy from the International Seismological Summary. The form is the same as in the earlier number for 1918–24, edited by Prof. Turner, of which it is a welcome and very useful continuation. The International Seismological Summary for the first quarter of 1931 is in the press.

River Dee (Aberdeenshire) Flow Records

THE private organisation under the direction of Capt. W. N. McClean, known as River Flow Records, has continued its survey of the River Dee, undertaken in connexion with the British Association meeting at Aberdeen in September last year, and has recently issued two sheets of diagrams covering the period January–June inclusive of this year, together with an explanatory memorandum which states that the diagrams represent readings of water-levels and river flows from a catchment area of 528 square miles, and that they include meteorological records of rainfall, temperature and wind over the same district. As the result of the study of these observations of the Dee area, which have now been kept for a year and a half, it is found that in a comparison of rainfall and run-off, the former is under-estimated. There is no actual measurement on the high mountains, and it may be said that rainfall measured in a rain-gauge is generally under-estimated; so that rainfall is admittedly only an approximation, whereas the measurement of flow by means of 'the most perfect apparatus existing in the country' is comparatively accurate. In the six months' period, the net aggregate of storage and run-off has reached just less than 19 in. out of a gross rainfall of 22½ in.

Electric Progress in Palestine

LORD READING, the chairman of the Palestine Electric Corporation, said at the annual general meeting on September 5 that electricity has played a leading part in the rapid economic development of Palestine. Last year the Corporation's revenue increased by 64 per cent, and 13,460 new consumers were connected. The generating plant now exceeds 40,000 kilowatts, and the existing transmission line from the first Jordan power house to Tel-Aviv will, at the present rate of growth, soon become inadequate to meet the consumers' load. Hence, a 12,000 kw. turbo-generator with the requisite boiler plant, transformers and switchgear has been ordered, and a second 66,000 kilovolt-transmission line will be

constructed. On the upper reaches of the River Jordan and Lake Tiberias, surveys are being carried out with the view of further hydroelectric development. Lord Reading stated that the demands in the Corporation's area are still far from the saturation point. As the policy of reducing tariffs wherever possible is being continued, the prospects are promising. As Palestine is practically a 'new' country from the economic point of view, it is not surprising that the company is already on a remunerative basis.

Sedimentation

BULLETIN 98 of the National Research Council of America (1935, pp. 246) embodies the report of the Committee on Sedimentation for 1932–34, and indicates the immense activity of investigators in this subject as well as of the members responsible for the report. The latter includes about a thousand references to current literature and in itself represents a commendable example of bibliographic and abstracting work. The topics discussed include European studies and varved sediments (Antevs); German contributions (Becker); studies at Stanford University (Blackwelder); glacial sediments (Leighton and Townley); British researches (Milner); mineralogy of sediments (Pettijohn); hydrologic and hydrographic investigations (Piper); chemical aspects (Steiger); recent sediments and petroleum source-beds (Trask); miscellaneous types (Twenhofel); marine bottom deposits (Vaughan); oxidation-reduction conditions in the Gulf of Catalina (ZoBell); and terminology of coarse sediments (Wentworth, with notes by Boswell). The last of these is a contribution of very general interest. The Sub-committee on Nomenclature and Classification of Sediments is studying the terminology of eleven groups, and in his introduction to the present report, Trowbridge holds out the prospect that following up the two reports already issued on volcanic and coarse sediments, others may be expected at the rate of two or more per year. The Committee is to be congratulated on the thoroughness of its work. It is obvious that without such a review geologists could not possibly keep in touch with the widely varied results of current progress in a branch of their science which is fundamental to its main object and to many of its applications.

Mining Legislation in South Australia

WE have received from the South Australian Department of Mines the *Mining Review*, No. 61, for the half-year ended December 31, 1934. After a short preface signed by Dr. L. Keith Ward, director of mines and also Government geologist, whose report appears afterwards, the review contains a summary of mining legislation, etc. A statistical portion which, together with a table at the end of the volume, shows that the total value of the minerals produced in South Australia since 1841 up to the end of 1934 equals 53¼ million pounds, taking gold at its old value. They also show a considerable increase both in quantity and value in 1934 compared to 1933, the quantity of iron ore produced in the former year being practically 1¼ million tons, showing an increase of half a million tons over 1933. Gold has naturally increased both in quantity and in value, and most other minerals show increases, though these in some cases are but slight, and actually show decreases in a few cases. Next comes a statement as to subsidies, from which it would appear that the amount advanced to various mines is nearly £71,000, of which a little more than £18,000 has been repaid. Next we have certain reports of treatment works and Government boring operations, followed by a short report by the Government geologist, and a series of reports by the chief inspector of mines, which give much detailed information about many of the mines of the Province.

Research on Shellac

IN 1925, the Indian Government founded the Lac Research Institute to ensure that the rapid development of rival products, and the high price levels reached in the post-War period, did not cause lac to meet the same fate that indigo had suffered previously. The results obtained during the first nine years work of the Institute and the present trend of the investigations have recently been published as an illustrated booklet in concise, interesting and non-technical form ("Lac and the Indian Lac Research Institute", by D. Norris, P. M. Glover and R. W. Aldis. Nankum: Lac Research Institute. Rs. 2.8). The lac insect yields both a colouring matter and a resin, and it was for the former product that it was originally cultivated. With the discovery of aniline dyes, however, the lac dye industry came to an end and the resin in unmanufactured form as lac, or the manufactured form as shellac, became the important feature of the industry. The uses to which shellac can be put are numerous, but the greatest proportion is adsorbed by the gramophone, electrical and varnish trades. The increasing use of synthetic resins such as bakelite inevitably threatened the industry, but as new methods have now been discovered whereby the natural product may be used in combination with the synthetic, the situation has improved. Research work is carried out on entomological, chemical and biochemical lines, many problems naturally occurring with regard to the insect and its host plant as well as the secretion of lac and its preparation for the market.

All-India Institute of Hygiene and Public Health

IN the annual report of the All-India Institute of Hygiene and Public Health, Calcutta, for 1934, the first to be issued, the events which led to the foundation of an All-India Institute of Hygiene are first recapitulated. The conception of providing courses of post-graduate training in public health originated with Sir Leonard Rogers, and as a result of his efforts the Calcutta School of Tropical Medicine was founded and opened in 1920. It was realised that there was also need for the training of an Indian personnel in public health, but circumstances prevented the realisation of this object until the Rockefeller Foundation offered to provide funds for a site, and for the

building and equipment of an institute, provided the Government of India undertook its maintenance. A site was acquired in 1930, and the building erected adjacent to the Tropical School, which was opened in 1932. The work of the Institute is carried on in six sections, and a representative staff has been appointed under the directorship of Lieut.-Col. A. D. Stewart, who is also the professor of hygiene. A description of the building is given, together with an account of the work of the sections, and of the research work that is in progress.

Food Poisoning

THE Ministry of Health has issued a memorandum on the steps to be taken by medical officers of health (outside London) in suspected cases of food poisoning (Memo. 188/Med.). The two classes of food poisoning are dealt with—contamination of food by poisonous chemicals and bacterial infections of food, which are far more frequent. Directions are given outlining the methods of investigating outbreaks, the collection of material for chemical or bacteriological examination, and method of packing and transmission to the Ministry, with hints on the chemical or bacteriological examination. In an appendix, a scheme is outlined for the routine inquiry into outbreaks of poisoning by meat foods, and in a second appendix valuable details are given for the isolation and identification of the bacteria (*Salmonella*) concerned in bacterial food poisoning.

International Congress on Soil Science

THE papers presented to the third International Congress on Soil Science, held recently at Oxford, embody work that is representative of most aspects of soil science; these are issued in two volumes (London: Thomas Murby and Co., 1935). The first volume contains those presented to the several commissions, and the second includes papers read at the plenary sessions, together with the address of the president, Sir John Russell. The papers are in English, French or German. The president, in his address, dealt with the contribution of soil science towards improving economic conditions, mentioning in particular the value of the surveying and mapping of soils as a preliminary to all schemes of agricultural development. As interesting examples of such contribution, those mentioned by Hardy, in his paper on "Some Aspects of Tropical Soils", may be quoted; these dealt more particularly with quantitative soil profile investigations. In the Caribbean region, for example, studies of this nature have rendered possible the exact definition of soil best adapted to the growth of several important orchard and field crops, and have made manifest certain soil factors that are definitely harmful to those crops. This aspect of soil work was dealt with by the commission on soil genesis, morphology and cartography and by that on the application of soil science to land amelioration.

No part of soil science stands to gain more from a Congress of this nature than that represented by those two commissions, since work in this field would lose much of its value without uniformity in methods of approach and expression of results. Studies on the composition and structure of the soil, divided for the purpose of the Congress into four commissions, namely, soil physics, soil chemistry, soil microbiology and soil fertility, reflect the progress that has been made in recent years in this aspect of soil work. Schofield made a contribution in which soil moisture relationships are regarded from a new point of view based on energy considerations, and introduced a scale to specify the degree of wetness or dryness of a soil; it was shown that by carefully distinguishing wetting from drying conditions, a more rational interpretation could be applied to data on plant wilting and field moisture capacity.

Cooke's Illustrations of British Fungi

A MAGNIFICENT series of eight volumes of "Illustrations of British Fungi" appeared towards the close of the last century. They were the work of Dr. M. C. Cooke, and served as a very pleasing and facile reference for naming the larger fungi. More recent advances in the scientific nomenclature of the Basidiomycetes, however, have shown that the names attached to the plates were not always correct. A great deal of confusion has resulted, and has somewhat diminished the usefulness of the work. Mr. A. A. Pearson has largely remedied this state of affairs, by publishing a modernised index to the "Illustrations" (*Trans. Brit. Mycol. Soc.*, **20**, Pt. 1, 33–95, Aug. 1935). This was originally based on notes prepared by Dr. Quélet, but Mr. Pearson also obtained the opinions of Prof. René Maire and Mr. Carleton Rea. These authorities concur upon a large number of species, but are by no means agreed upon others. The student of mycology will, however, be able to find the highest common factor between them where necessary, and will be able to use his Cooke's "Illustrations" again, with reasonable accuracy.

Fossil Elephants in Eldorado

A NOTABLE discovery of the remains of the extinct Columbian elephant, one of the largest of elephants, is recorded from Eldorado, Oklahoma, by Science Service, Washington, D.C. The University of Oklahoma and Kansas State College have united in excavating certain mounds in which casual digging had revealed fossil bones, and the first results include seven skulls and many bones, tusks and teeth of the species referred to. The elephant remains range from those of mature individuals to young ones, five to seven years old. In addition to these remains, bones of extinct species of camel, horse and bison have been excavated. It appears that the area of the discoveries was an ancient water-hole which had a bottom of very soft mud in which the animals had become bogged.

Guide to Statistics

THE "Guide to Current Official Statistics of the United Kingdom", for 1934 (H.M. Stationery Office. 1*s.*), has recently been published. This guide, now in its thirteenth year, has become almost indispensable

to all workers who have to deal with blue books and other official papers. It is so arranged that with a minimum of delay it is possible to find what statistics are available on any given subject. The degree of analysis of the figures, the dates and places to which they apply, and the price of the volumes containing them can be readily found. There is also given a list of the publications of various Government departments arranged under the departments.

National Radium Commission

THE new National Radium Commission has been elected and consists of the following members: the Earl of Donoughmore (Chairman), Sir Cuthbert Wallace (Vice-Chairman), Dr. T. Carnwath, Dr. T. Ferguson, Dr. Rupert Hallam, Dr. G. W. C. Kaye (appointed by the Department of Scientific and Industrial Research), Prof. J. C. G. Ledingham (appointed by the Medical Research Council), Mr. J. J. M. Shaw, Mr. G. F. Stebbing, Prof. Beckwith Whitehouse, Prof. James Young; *Joint Secretaries*, Dr. G. W. C. Kaye and Mr. G. F. Stebbing; *Office Secretary*, Miss K. Griffiths. The Commission will meet as heretofore at 5 Adelphi Terrace, Strand, W.C.2.

The Sky in October

ALL the naked-eye planets are now absent from the evening sky except Saturn, which is conspicuous and fairly well placed for evening observation: the stellar magnitude will decline from $+0{\cdot}8^m$ to $+1{\cdot}0^m$ during the month, but the planet is rather far south, as also was Jupiter this summer, Saturn's declination being $-11° 50'$ on October 15. Venus is now an early morning object, and will attain its greatest brilliance on October 15. Mars and Jupiter are both near the sun. Uranus will be in opposition on October 27, and there will be a conjunction of Neptune with Venus on October 25, Venus being 2° 6′ S. The minor planet Vesta is now in the evening sky, not far from Saturn. Intensive observations on the minor planets have been started at Greenwich, in pursuit of a plan for making greater use of these small objects for determining the position of the equinox. They just show a disc in the 8-in. transit telescope, but resemble a star far more closely than does Venus (and *a fortiori* the sun), so that the minor planets are very suitable objects to observe in order to tie up the right ascensions and declinations of the solar system with the fundamental right ascensions and declinations of the stars. The principle involved is that the observation of a planet from the earth is equal and opposite to an observation of the earth from the planet, so that besides observing the planet's orbit we observe our own, and find the point where our orbit cuts the equator, that is, the equinox.

Announcements

THE opening lecture of a series on "Scientific Progress" organised by the Sir Halley Stewart Trust will be given by Sir James Jeans in the Memorial Hall, Farringdon Street, London, on Tuesday, October 22. The subject will be the new world picture as seen by the modern physicist. Other contributors to the series are Sir William Bragg, Prof. E. V. Appleton, Prof. E. Mellanby, Prof. J. B. S. Haldane, and Prof. Julian Huxley. Free reserved tickets are obtainable from the Trust, 32 Gordon Square, W.C.1.

THE Robert Koch medal has recently been awarded by the City of Berlin to Dr. Ferdinand Sauerbruch, professor of surgery in Berlin, the Emil Fischer medal to Dr. Adolf Butenandt, professor of organic chemistry and technology in Danzig, and the Liebig medal to Dr. Walther Roth, professor of physical chemistry at Brunswick.

A LECTURE on the work of the expedition of the Egypt Exploration Society (2 Hinde Street, W.1) to Tell el-Amarna 1934–5 will be given by the field director, Mr. J. D. S. Pendlebury, on Monday, October 7, at 8.30 p.m. in the rooms of the Royal Society, Burlington House, Piccadilly, London, W.1.

THE sixtieth series of free lectures at the Horniman Museum, Forest Hill, S.E.3, will begin on October 12 at 3.30, when Mr. E. C. Stuart Baker will lecture on "Wild Men and Wild Beasts in India". Further information can be obtained from the Curator of the Museum.

IT has come to the notice of the National Institute of Agricultural Botany that a Danish 're-selected' stock of Resistance Oats is being offered on the English market. The Institute desires to state that no seed of this variety was distributed prior to the autumn of 1934.

THE Electrodepositors' Technical Society, which has been responsible for the organisation of the Electrodeposition Exhibition in the Science Museum at South Kensington, will hold a Soirée in the Museum on October 18. The Exhibition will be open from 6.15 until 10.30 p.m., during which time a lecture will be given by Mr. S. Field on progress in electrodeposition and a film will be shown dealing with commercial applications of electrodeposits. Admission to the Museum will be by ticket. The Society welcomes applications from members of kindred societies and institutions and from others interested in the theory or practice or applications of electro-deposition. Applications should be made immediately to the assistant hon. secretary, Capt. A. I. Wynne-Williams, 12A, Raleigh House, Larkhall Estate, London, S.W.8.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant in the London Museum, St. James's, S.W.1—The Keeper (Oct. 28).

A secretary for the Society for Cultural Relations with the U.S.S.R., 21 Bloomsbury Square, London, W.C.1—The Chairman.

A woman lecturer in geography and mathematics in St. Hild's College, Durham—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 554.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Physical Units and their Dimensions

HAVING an interest in astrophysics, and chemistry, and telegraphy, for each of which some knowledge of electrical quantities and relations is required, more than I can carry in my head, a problem arises where to find it. It has been solved for my case by use of a single page appendix to a treatise on astronomy, which I keep handy with the page turned down, and which provides all that I need. I would not dream of remembering the complexities of nomenclature of an electrotechnical handbook. I observe that all this is now in the melting pot again, with its 'gilbert, gauss, oersted and maxwell' and so on, under new international auspices of some kind, to judge by letters in NATURE which I do not comprehend even by guesswork. Do the technicians of the great industrial corporations really desire to cut themselves off from the general sciences, or do they merely ignore this activity as a play of professors ?

I am old enough to remember the beginnings of standard technical units, first in Kelvin's laboratory owing to the needs of submarine telegraphy, extended later to marvellously precise measurements mainly in the Cavendish Laboratory under Rayleigh's guidance, with results in values and nomenclature adopted into a universal practice mainly through Kelvin's international diplomatic gift. Once the now familiar c.g.s. unitary frame was adopted, the relevant electric unitary quantities followed, from their mutual relations in terms of one of them, thus forming a linear system, their dimensions as deduced from illustrative examples relative to the frame presuming that their relations are for all such examples of mutually consistent mechanical type.

It appears that the electrotechnicians are now invited to inhabit a world of their own in which c.g.s. are replaced by M.K.S., one moreover in which even the classical electrodynamic equations may be replaced by new ones peculiar to them. The standard units on the original c.g.s. frame were indeed in like manner too small for practical electric purposes, and were changed by the original founders to a secondary system affected by powers of 10, for example, a secondary unit concisely specified as 10^8 c.g.s. being named out of international compliment a volt, and so on. This correlation by factors that are powers of 10 appeared to be simple and universally acceptable. But these secondary units must also be bound together by a basic system of their own, to replace cm., gr., sec. I find on consulting § 620 of the relevant chapter (not too lucid) of Maxwell's "Treatise", a book now almost as obsolete as the "Principia", that this necessary basic system is 10^9 cm., 10^{-11} gm., sec. Thus the secondary unit of mechanical force would be 10^{-2} dyne, and so on: on the M.K.S., namely, 10^2 cm., 10^3 gm., sec. frame now apparently proposed, it would be 10^5 dyne. These extensions into mechanics have, however, hitherto been scarcely thought of: while the concise device of powers of 10 as ratios of the units of the same entity that arise has proved precise and adequate without divorce of electrotechnic theory from the scheme of general science. Why cannot it be let alone ? But, by the way, on the other side of this account, may not the use by theorists, now introduced into Britain, of the hybrid electric unitary system favoured by Helmholtz, be a cause of dimensional inconsistencies as possibly felt by practicians ?

A deeper analysis in this regard, indicating a wider significance, is suggested. To secure unambiguous dimensions, the units must be a linear scheme with freedom of transformation backwards and forwards. This can be so, because there is presumed to be a unique ultimate theory which has to be on a mechanical basis as resting on length, mass, time, a presumption which might be called the Kelvin postulate. But regions of this final connected map of phenomena are concealed, and the partial effective theories, for example, the familiar electrostatic and the electromagnetic developments, are built up by working round these blank regions in different ways, establishing contacts where feasible while *ex hypothesi* they cannot show mutual contradictions. Thus, the test that every term in a summation formula must have the same dimensions is an indirect probe that the formula conforms to this unique ultimate foundation scheme. The assignment of dimensions to K or μ, after Rucker, promotes this unification of all systems of units virtually by adding a fourth variable to the c.g.s. three. The deeper significance for dimensions thus indicated has its origin historically with Gauss and Weber, rather than with Newton or Fourier; for they explored and compared the two widely removed paths of experimental entry into what proved to be the same range of phenomena of electrics, and identified them as far as might be; as is illustrated by Weber's recognition that the two resulting modes of measure of charge must be connected in terms of a velocity, while his experiments indicated, almost before its time, in advance of theory, that the velocity of light is here involved.

JOSEPH LARMOR.

Holywood,
Co. Down,
N. Ireland.
Sept. 11.

Magnetic Storms and Upper-Atmospheric Ionisation

Now that measurements of upper-atmospheric ionisation can be made, using methods of radio exploration, it is of interest to see whether abnormal values of ionisation density are associated with periods of magnetic activity. We have conducted such an inquiry using the measurements of ionisation density in Region F_2 of the ionosphere made at the Radio Research Station, Slough, together with the daily magnetic character figures from the Abinger Observatory supplied to us by the Astronomer Royal.

Since magnetic activity is, in this latitude, most pronounced just before midnight, we have taken the midnight values of the critical penetration frequency of Region F_2, which is a measure of the maximum electron density, as the daily index of ionisation, and compared it with the magnetic character figure for the preceding twenty-four hours. In order to allow for the seasonal variation of ionisation, the daily departure of the critical penetration frequency from the appropriate value on a smooth curve drawn through the monthly means has been used as expressing whether a particular daily value was abnormally high or low.

The results of this examination show that when there is a small amount of magnetic activity the ionisation is above normal, but that when the activity is more severe the critical frequency is much depressed, indicating a reduced value of the maximum electron content. The correlation factor for the two quantities, (1) departure of midnight critical frequency from normal, and (2) magnetic character figure, has been found to be $-0{\cdot}247$ for the year 1934, thus showing the slight preponderating influence of the negative correlation with large storms.

Now an increase of ionisation density would receive a ready explanation in terms of current theories of the production of magnetic storms by the injection in the upper atmosphere of ionising particles from the sun, but a decrease of ionisation density seems more difficult to explain. It has, however, been recently shown[1] that the abnormally low daytime ionisation densities observed in summer for Region F_2 are to be attributed to the influence of atmospheric heating by solar radiation. It seems possible to explain the low value of night-time maximum ionisation density associated with marked magnetic activity in a similar manner. If the agency responsible for magnetic disturbances heats the upper atmosphere so that it expands, the maximum electron density will be correspondingly reduced.

A study has also been made of the connexion between magnetic activity and noon values of maximum ionisation in Regions F_1 and F_2, but here the results obtained are not quite so simple. It is true that intense storms are often accompanied by marked reductions in the critical frequencies of both regions, and especially is this found to be the case at the equinoxes, but we have noted a number of cases where the critical frequencies are actually markedly increased when a large storm is in progress. More often than not, the departures of the critical frequencies for the two regions from the appropriate mean curves are in the same sense, though they are much greater for Region F_2 than for Region F_1. An inverse correlation between earth currents and Region F_1 ionisation has already been noted by Schafer and Goodall[2], but they were unable to find any connexion in the case of Region F_2 ionisation.

This work has been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.

Halley Stewart Laboratory,
King's College, London.

L. J. INGRAM.

Radio Research Station,
Slough.
Sept. 24.

[1] Appleton, *Phys. Rev.*, 47, 89; 1935. Appleton and Naismith, *Proc. Roy. Soc.*, A, 150, 685; 1935.
[2] Schafer and Goodall, *Proc. Inst. Rad. Eng.*, 23, 670, 1935.

Hydrogen in the Upper Atmosphere

ONE of the most striking characteristics of both auroral and night-sky spectra is the absence of hydrogen lines. So far as I am aware, not even a trace of the atomic or molecular spectra of hydrogen has ever been observed in either of the above spectra. The question is immediately raised, does this absence prove that there is no hydrogen in the upper atmosphere at the heights at which night-sky and auroral spectra have been photographed? It is the purpose of this note to discuss briefly the answer to this question.

In order to do this, it is necessary to recall some of the recent experiments carried out by me on the laboratory production of auroral and night-sky spectra. In order to produce either of these spectra, it is necessary first to prepare an uncondensed electrical discharge in nitrogen which is accompanied by a strong afterglow. It must be pointed out here that the best known nitrogen afterglow is the one which accompanies a condensed discharge in nitrogen, and that it was not until 1931 that the afterglow accompanying uncondensed discharges was discovered. It is much more difficult to prepare a tube which will show an afterglow when an uncondensed discharge is passed through it than one which will show the afterglow with a condensed discharge. In fact, the former afterglow was discovered in a tube which had been run for about two weeks during which all the impurities such as oxygen, carbon compounds and hydrogen were cleaned up. After many trials it was found that the preparation time could be greatly shortened if hydrogen were not present in the initial gas. Thus, in preparing tubes at the present time, whenever the tube fails to show an afterglow immediately, it is pumped down, say, from 10 mm. to about 10^{-3} mm. and in every case H_α and H_β are present in the light emitted by the tube. Repeated experiences show that a very small amount of hydrogen completely changes the spectrum and behaviour of nitrogen tubes. When it is present, no afterglow accompanies the uncondensed discharge, and when it is absent the discharge is accompanied by a strong afterglow the spectrum of which is that part of the auroral spectrum that is emitted by nitrogen.

The hydrogen may inhibit the afterglow by being adsorbed on the walls of the tube, thus preventing the adsorption of nitrogen atoms and their subsequent recombination to form the metastable molecules which seem to be necessary for the existence of nitrogen afterglows. The effect of the hydrogen may, however, be a space, rather than a surface, effect. If this should be true, then one must conclude that there is so little hydrogen in the upper atmosphere that it does not prevent the production of the auroral spectrum. In fact there should be a steady change of the auroral spectrum with the amount of hydrogen present in the region where it originates.

Before it will be possible to use the effect of hydrogen on the nitrogen afterglow, to study the hydrogen in the upper atmosphere it will be necessary to distinguish between space and surface effects. Experiments are now in progress to achieve this. Should it turn out to be a space effect it will be necessary to study the changes in auroral spectra with height.

In closing, it should be pointed out that several authors have identified certain night-sky spectra in

the red as water-vapour bands. While this identification is not certain, it at least suggests that the hydrogen in the upper atmosphere is present as part of the water molecule. While this may be reasonable for the light of the night-sky, one would expect water-vapour to be dissociated during auroral displays. Furthermore, no water-vapour bands have been observed in auroral spectra.

Although the present evidence is not conclusive, it was thought worth while to direct attention to this remarkable effect of hydrogen on the nitrogen afterglow and to its possible relationship to the question which was put at the beginning of this note.

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Aug. 30.

Statistical Tests

PROF. FISHER[1] is an apt controversialist, but he knows as well as I do that what I understand by *graduation* is not confined to *curves*; that I should term graduation the fitting of a binomial to a series of observations, or the determining whether a system of correlation coefficients could be reasonably supposed to have arisen from samples of material drawn from a population with a given correlation coefficient. The difference between Prof. Fisher and myself lies in the use (and abuse) of the acceptance and rejection of 'hypotheses'. There is only one case in which an hypothesis can be definitely rejected, namely, when its probability is zero. He cites a case which I criticised in the paper he refers to, in which two recessives (say) had produced a dominant, and theory was absolutely contradicted. It did not require an *application* of the (P, χ^2) test to assert that either theory or observations must be rejected! I merely showed that the (P, χ^2) test did not fail in this case. But let us look into what actually happens, and I cannot do better than illustrate it on some statistics provided by Sir James Jeans in NATURE of September 14, 1935 (p. 432). He is comparing the eccentricities of visual binaries, 116 in number, against a theory of equipartition (not a *curve*, but frequencies are considered). His data expressed by a frequency series run as follows:—

Eccentricity.	Observed.	Theory for 116 stars, $e<1$	Theory for 83 stars, $e \leqslant 0{\cdot}06$.
0·00–0·01	0	4·5	9
0·01–0·02	11		
0·02–0·03	9	6	12
0·03–0·04	14	8	16
0·04–0·05	24	10·5	21
0·05–0·06	25	13	25
0·06–0·07	6	15	—
0·07–0·08	18	17	—
0·08–0·09	7	20	—
0·09–1·00	7	22	—

If the P, χ^2 test be applied to the total 116 binaries, we have $P < 0{\cdot}000{,}0005$. On the other hand, if it be applied to the 83 stars of lowest eccentricity, $P = 0{\cdot}79$. In neither case can you say the hypothesis is true or false. You reject it in the former case because it is a poor graduation, you say in the latter case that it is a reasonably good graduation because 79 per cent of random samples would, were the 'hypothesis' true, give a worse result than the observations do. But in accepting it as a working graduation, you do not assert its truth any more than you assert the falsity of the hypothesis applied to the whole 116 stars; you merely say the latter is a bad graduation, and try for a better. Had Sir James Jeans taken all stars with eccentricity $\leqslant 0{\cdot}07$, instead of $\leqslant 0{\cdot}06$, he would have found $P = 0{\cdot}105$, and if he had proceeded to $e \leqslant 0{\cdot}08$, the result would have been $P = 0{\cdot}00001$, that is, he might have got a worse sample in 100,000 trials. Actually he gives his reasons for cutting off the higher eccentricities. With them I am not concerned, although the exact cutting off at $e = 0{\cdot}06$ is not discussed; the difficulty of detecting high eccentricity binaries and of then determining their orbits may account for the irregularity of the last four frequency entries, as he holds, or there may be other reasons why the falling-off occurs at $e = 0{\cdot}06$. *Hypotheses non fingo!*

Now Prof. Fisher refers to rejecting hypotheses as a function of the P, χ^2 method, and of accepting them as a logical fallacy. I have in my letter of August 24 stated that the tests are there to ascertain whether a reasonable *graduation* has been reached; not to assert whether one or other hypothesis is true or false. We should accept Sir James Jeans's equipartition as a reasonable graduation for the observed binaries $e \leqslant 0{\cdot}06$ ($P = 0{\cdot}79$) and reject it as a graduation for the observed binaries $e \leqslant 0{\cdot}08$ ($P = 0{\cdot}000{,}01$). It is not for statisticians to say whether an hypothesis is false except when $P = 0$. All that they can legitimately say is that it gives a poor *graduation*. In particular, it is very unwise in *my* opinion to form tables which provide only the values of $P = 0{\cdot}01$ and $P = 0{\cdot}05$, and consider 'hypotheses' which give a value of $P < 0{\cdot}01$ as 'false', and those with a value between 0·01 and 0·05 as 'doubtful', and for the rest of the scale of P have no descriptive category, for you must not say that such values prove hypotheses to be true. Hence I repeat my assertion, in the face of all the authority of Prof. Fisher and his followers, that all the P, χ^2 test ascertains is goodness of graduation, and I hold that 'goodness' of graduation is relative to the nature of the material investigated, our experience of similar material and the purpose to which we intend to put our graduation. The value of P at which we consider goodness or badness of graduation starts cannot be fixed without regard to the special problem under consideration.

There seems somewhere a logical fallacy in the position of both Prof. Fisher and Mr. Buchanan Wollaston. They both apparently assert that the P, χ^2 test enables one to say an hypothesis is false, yet never to say that an hypothesis is true, but if an hypothesis be *false*, its reverse must be true. If you assert that the hypothesis that a sample is drawn from a normal curve is false, the reverse hypothesis that it is *not* drawn from a normal curve must be true. As a matter of fact, the P, χ^2 test has only measured its 'goodness of fit' by a probability coefficient, and it is as idle to say as a result of it, that the hypothesis is 'false', as that the reverse of it is 'true'. The only exception to this rule is when the observations show the existence of individuals in a frequency class which the hypothesis asserts cannot exist.

The 'laws of Nature' are only constructs of our minds; none of them can be asserted to be true or to be false, they are good in so far as they give good fits to our observations of Nature, and are liable at any time to be replaced by a better 'fit', that is, by a construct giving a better graduation.

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[1] NATURE, 136, 474, Sept. 21, 1935.

Stereoscopic Photography

IN "A Note on Stereoscopic Photography"[1] Dr. John R. Baker refers to different methods of making stereoscopic photographs of near objects. There are two possibilities: the axes of the cameras can be parallel to each other, or they can be convergent to the object. Dr. Baker concludes: "The convergent camera gives the proper representation of the object". I think this conclusion is not right. Let us consider a moment a photograph made by a camera in an arbitrary position. It always represents reality if we look at it in the right manner. It is necessary to put the eye in the place occupied by the lens in making the photograph, and the different points of the image will be seen under the same angles as the corresponding points of the object. In Fig. 1 of Dr. Baker's article both photographs have to be seen from D and so A' and A'', B' and B'', and C' and C'' are seen in the same direction.

In choosing the right lenses for the stereoscope, it is possible to look at both photographs in the right manner. So each eye gets the same impression it should get in reality, and there is only left the possibility that both eyes, in looking to some detail, should have a position to each other different from that which they should have in reality. It is here there is a real difference between both methods. With convergent cameras we get the images of the object in the centre of the plate and in looking at them in the stereoscope the axes of the eyes will be parallel. With parallel cameras the images come more to the border, and in looking at them the axes of the eyes will be convergent. Here the effect of the parallel cameras is more according to reality, but the eyes are very insensitive to the difference. So the impression is the same in both circumstances.

It may be mentioned that one real advantage of the method of convergent cameras is a relatively big field of view, as only the common field of view of both cameras contributes to the stereoscopic impression.

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[1] NATURE, 136, 193, August 3, 1935.

IN looking at a near object, the eyes are turned inwards. Therefore to procure a really natural stereoscopic view of two photographs of a near object, the eyes should be turned inwards at the same angle. To achieve this, the two photographs should be mounted in such a way that the corresponding points in them are nearer than the interpupillary distance. With this arrangement, it is true that proper stereoscopic views may be obtained with photographs of near objects taken with parallel cameras; but if the corresponding points in the two photographs are separated by approximately the interpupillary distance (as in normal stereoscopic photography), a wrong impression is conveyed to the eyes.

Convergent vision with the stereoscope presents two difficulties. First, most people (as I have found by painful experience at conversaziones) are unable to fuse the images with a convergent stereoscope: when a person holds a stereoscope to his eyes, he reflexly directs his eyes for parallel vision. Secondly, the placing of the corresponding points in the two photographs nearer together than the interpupillary distance narrows the possible field of view.

For these reasons I nowadays keep to the standard stereoscope and use parallel vision, insisting only that to each eye there shall be presented exactly the view that would be obtained if one were looking at the object with one's eyes in the positions of the lenses of the cameras when the photographs were taken. This can only be achieved by using convergent cameras (or by using the equivalent, the tilting stage method, in stereo-photomicrography).

If the convergent stereoscope did not present the two disadvantages mentioned above, the ideal method for the stereoscopic photography of near objects would be the following. The photographs would be taken by convergent cameras (or by the use of the tilting stage). A convergent stereoscope would be used for viewing, and the two photographs would be arranged in the stereoscope in two different planes at right angles to the two lines of vision.

I wish to acknowledge the benefit of discussions on this subject with Prof. F. A. Lindemann and Mr. S. J. Baker.

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Sept. 2.

Raman Spectrum of Heavy Water

THE Raman spectrum of heavy water was first studied by Prof. R. W. Wood[1], who obtained a strong band at 2517 cm.$^{-1}$. For the vapour of heavy water, Rank, Larsen and Bordner[2] found a line at 2666 cm.$^{-1}$, while Wood has reported a line at 2601 cm.$^{-1}$. These results are evidently incomplete. In view of the great interest attached to this substance, it appeared worth while to re-examine the matter, using 50 gm. of 99·2 gm./100 gm. D_2O (d_4^{20} 1·1049) supplied by the Norsk Hydro-Elektrisk Kvaelstofaktieselskab. The Raman spectrum of the substance was photographed with a Hilger two-prism spectrograph with about 72 hours exposure, and is reproduced as Fig. 1.

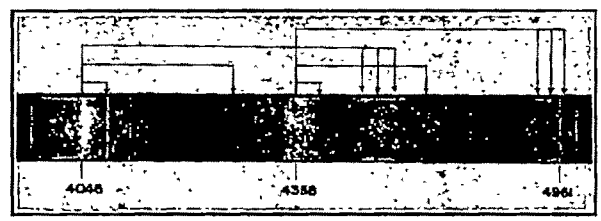

FIG. 1. Raman spectrum of heavy water.

The spectrum shows a number of interesting features which have not been noticed by the previous workers.

1. The principal band is seen to consist of three imperfectly resolved components of frequency shifts 2646 cm.$^{-1}$, 2500 cm.$^{-1}$ and 2366 cm.$^{-1}$. These correspond to the components 3630 cm.$^{-1}$, 3435 cm.$^{-1}$ and 3200 cm.$^{-1}$ reported for ordinary water, and indicate that heavy water is polymerised in a very similar way to ordinary water.

2. A new band with a frequency shift of 1231 cm.$^{-1}$ is very clearly seen with both the 4358 A. and 4046 A. excitations. Careful examination of the plate reveals faint components to this on either side, the central component of the triplet being by far the brightest. The position of this band compares

very favourably with the frequency 1250 cm.$^{-1}$ calculated from the theory of the molecular vibrations of three-particle systems put forward recently by Van Vleck and Cross[3]. It is interesting to note that a similar, but very feeble, band of frequency shift about 1650 cm.$^{-1}$ has been reported in the case of ordinary water[4].

3. A third band with a much lower frequency shift of 178 cm.$^{-1}$ is also noticed with both the 4358 A. and 4046 A. excitations. This frequency is far too low to be attributed to the internal vibrations of the D_2O molecule, and hence is presumably due to some sort of rotation or vibration of the molecule as a whole. The Raman spectrum of ordinary water also shows a band at approximately the same position. This band is evidently to be ascribed to the frequency of hindered rotation or oscillation of the liquid molecule, of which independent evidence is forthcoming from studies of dielectric constant[5], infra-red absorption[6], viscosity, etc.

A detailed paper on the subject will appear in the *Proceedings of the Indian Academy of Sciences.*

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Aug. 10.

[1] R. W. Wood, *Phys. Rev.*, **45**, 392; 1934.
[2] D. H. Rank, K. D. Laisen and E. R. Bordner, *J. Chem. Phys.*, **2**, 464; 1934.
[3] See B. Topley and H. Eyring, *J. Chem. Phys.*, **2**, 217; 1934.
[4] M. Magat, *J. Phys.*, **5**, 347; 1934. G. Bolla, *N. Cimento*, **10**, 101; 1933.
[5] P. Debye, *Phys. Z.*, **36**, 100, 193; 1935.
[6] C. H. Cartwright, NATURE, **135**, 872; 1935.

Diffusion of Heavy Water into Ordinary Water

W. J. C. ORR and D. W. Thomson[1] have found the velocity of diffusion of HDO into H_2O to be abnormally large, the diffusion constant D being 9×10^{-4} cm.^{2} sec.$^{-1}$ at 15° C., whereas for all simple substances in water, diffusion constants are of the order of magnitude 10^{-5} cm.^{2} sec.$^{-1}$. Since this result, if it were true, would be of considerable significance for the theory of the structure of water, experiments were made to verify it.

The velocity of diffusion was measured with a micropyknometer of E. S. Gilfillan and M. Polanyi[2]; the orifice was made larger than usual (namely, about 0·1 mm.) to make noticeable the diffusion from the body of the pyknometer into the surrounding water.

The method of carrying out the experiments was as follows:

At the beginning the difference $(\Delta P)_1$ in equilibrium hydrostatic pressure for the solution and ordinary water was measured. Diffusion from the pyknometer was allowed to occur, in a separate vessel at constant temperature and for a given length of time t, and the measurement of the difference in the equilibrium hydrostatic pressure was repeated, giving $(\Delta P)_2$.

From Fick's law, the following equation can be easily obtained:

$$\lg\frac{(\Delta P)_1}{(\Delta P)_2}/Dt = K,$$

where K is a constant.

Constant K was obtained from observations of the diffusion of potassium chloride solution, employing data of the International Critical Tables for the diffusion constant. All experiments were duplicated, results agreeing within 5 per cent.

The following values of D were obtained for the diffusion of heavy water from ~ 3 mol. per cent solution into ordinary water.

$$D = 1{\cdot}1 \times 10^{-5} \text{ cm.}^2 \text{ sec.}^{-1} \text{ at } 0{\cdot}0° \text{ C.}$$
$$D = 2{\cdot}5 \times 10^{-5} \text{ cm.}^2 \text{ sec.}^{-1} \text{ at } 28{\cdot}0° \text{ C.}$$

Hence the constants are of the usual order of magnitude, contrary to the result of Orr and Thomson.

My thanks are due to Prof. M. Polanyi for the use of the micropyknometer apparatus and for much valuable discussion.

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[1] NATURE, **134**, 776; 1934.
[2] *Z. phys. Chem.*, A, **166**, 254; 1933.

Identity of Natural Vitamin D from Different Species of Animals

BILLS, Massengale and Imboden[1] have found that one rat unit of blue-fin tunny liver oil in chicks has only 15 per cent of the antirachitic effect of one rat unit of cod liver oil, whence they conclude that the two forms of vitamin D are different. However, Dols[2] demonstrated that the antirachitic effect of these two forms of vitamin D in chicks is the same, the necessary dose being about 80 international D units a day for each chicken. Before the results of Dols were known to us, we had running a great number of tests to investigate whether there is any difference between the vitamin D of different species of animals. (The fact that there is another form of natural vitamin D found in green plants and accompanying the free fatty acids[3] is not discussed here.)

From the different fats under investigation the unsaponifiable fraction was first isolated, the vitamin A eliminated and the vitamin D to some degree concentrated by a method reported by us[4]. We have examined the liver fat as well as the body fat of the following species: coalfish (sei, *Gadus virens*), cod (torsk, *Gadus morrhua*), cusk (brosme, *Brosmius brosme*), dogfish (hå, *Squalus acanthias*), dorn (piggrokke, *Raja clavata*), Greenland shark (håkjerring, *Somniosus microcephalus*), haddock (kolje, *Gadus æglefinus*), halibut (kveite, *Hippoglossus hippoglossus*), herring (sild, *Clupea harengus*), mackerel (makrel, *Scomber scombrus*), pollack (lyr, *Gadus pollachius*), redfish (uer, *Sebastes marinus*), salmon (laks, *Salmo salar*), shark (håbrand, *Lamna cornubica*), sprat (brisling, *Clupea sprattus*), tunny (makrelstorje, *Thunnus thynnus*), wrasse or 'Old Wife' (berggylte, *Labrus berggylta*), blue whale (blåhval, *Bolæna musculus*); we also had specimens of vitamin D from the liver and body fat of a cow and of a human female. We found no difference between the antirachitic effect in chicks of all these fats, the daily dose required being in all cases 70–80 international D (rat) units per chicken.

We were thus able to confirm Dols's results but not the results of Bills *et al.* with tunny liver fat None of the preparations investigated by us showed a maximum of absorption in the ultra-violet spectrum at 260–270 mμ nor any rotation of the plane of polarisation in alcoholic solution, and the degree of

esterification with phthalic anhydride and pyridine after 10 days was 100 per cent. Maleic anhydride had no effect upon the present vitamin D[4]. There is thus no evidence that the vitamin D in all the fats investigated is not the same. A detailed report will appear in the near future.

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Sept. 7.

[1] *Science*, 80, 596; 1934.
[2] Diss. Wageningen, 1935.
[3] NATURE, 133, 533; 1934.
[4] NATURE, 136, 396; 1935.

Effect of Low Temperature upon Trypanosomes (*Trypanosoma equiperdum*) in Mammals

THE study of dormancy and under-cooling of animals has shown that the process of cooling sharply slows down all physiological functions. Yet the decrease in the rate of different functions is not the same[1,2]. In connexion with these observations a new question has arisen: In what way will the fall of temperature of the body of an animal influence micro-organisms infecting it?

Experiments were made with two species of bats, namely, *Nyctalus noctula*, Schr., and *Pipistrellus nathusii*, Keys. et Blas, which were infected with *Trypanosoma equiperdum*. For inoculation, blood was taken from the tails of white mice when the number of trypanosomes in the blood attained 9–10 in the field of vision. Into the skin of the abdomen of bats 0·01 c.c. of blood was introduced. A group of these animals was kept in an active state at a temperature of + 20° to 25° to study the normal course of infection. The second group of animals was placed immediately after the inoculation into cold boxes with a temperature of + 10° and + 3°. Every day from the vein of the membrane of the 'wing', blood was taken and the number of trypanosomes was counted in the dark field. The temperature of the bodies of bats was determined by means of a thermopile as described previously[2].

Trypanosomes multiplied very quickly in the blood of bats in the active state. During the period of 4–5 days the number of parasites in the blood reached 10–20 in a field of vision, on the 6–7 day the trypanosomes were abundant, and on the 9–13 day the animals died.

In experiments with animals placed immediately after infection into ice-boxes with a temperature of + 10° and + 3°–4° it could be seen that the infection in the organism of bats does not develop during a period of 8–15 days. Having raised the temperature after the expiration of this period and having kept the bats in this condition for about 3–5 days, we were still unable to detect any traces of infection. Subsequent infection of them with a new virus was quite successful, which showed the absence of immunity. In other words, the absence of blood parasites was retained from the first infection.

We also conducted experiments by cooling the animals after infection had already developed. For this purpose, a group of active (control) animals, at the moment when the number of trypanosomes in their blood reached a high level, that is, 1–10 trypanosomes per field of vision, were transferred to ice-boxes. After a cooling period of 3–8 days (at temperatures of + 3° and + 10°) the parasites completely disappeared from the blood of the bats. 2–4 days after the disappearance of trypanosomes from the blood, the animals were warmed, and placed in the same conditions as those under control (with a body temperature of 33°–37°).

The blood of the bats during 2–5 days after their being warmed was also without any parasites. Experiments with repeated infection have shown the absence of immunity in the animals, in other words, the absence in their organisms of trypanosomes from the first inoculation.

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[1] N. Kalabuchov, *Zool. Jahrb. Abt. Physiol.*, 53, 4; 1934.
[2] N. Kalabuchov, *Zool. Jahrb. Abt. Physiol.*, 55: 1935.

Parexocœtus, a Red Sea Flying Fish in the Mediterranean

FLYING fish from the eastern part of the Mediterranean are very little known, and most identifications have not been controlled by comparison with material from the Atlantic.

Dr. E. Liebman, of Jerusalem, has recently sent me two specimens from the Palestine coast, both of which are adults (standard lengths 95–103 mm.) of the primitive genus *Parexocœtus*, Bleeker. *Parexocœtus* has not been recorded from the Mediterranean before. They belong to the species *P. mento*, C. and V., as defined in my recent revision of the Atlantic Exocœtids[1]; but whether they are derived from the Atlantic subspecies *atlanticus*, Bruun, or are of Red Sea origin may be questioned. Klunzinger's species *gryllus* from the Red Sea is certainly a *Parexocœtus*, and most likely a subspecies of *P. mento*. The numerical characters of the two specimens received (*D.* 9–10, *A.* 11, *P.* 13–14, vert. 36–37, gill-rakers 28–29) indicate closer relationship to *P. m. gryllus* than to *P. m. atlanticus*, which is only known from the Cape Verde region.

Therefore it seems very possible that *P. mento*, one of the neritic flying fish, has passed through the Suez Canal and found a new breeding place in the innermost, warmest part of the Mediterranean.

It would be of great interest to study closely the racial characters of the Mediterranean and Red Sea populations of this flying fish and the eight or nine other species of fish, which Liebman[2] has recently recorded as Red Sea immigrants into the Mediterranean. Naturally, equal interest would be connected with immigrants in opposite direction. If no investigator is available to take up this question at present, it is suggested that museums and biological stations of that region should take immediate steps to secure abundant material for a future study. The life-conditions in the two seas are so different that environmental influence, sooner or later, will almost certainly be traced in the immigrated stocks. In any event, this large-scale experiment on geographical differentiation deserves to be followed very closely.

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[1] Bruun, Dana Report, No. 6, 1 (Copenhagen, 1935).
[2] Liebman, *Rapp. Proc.-Verb. Réun. Comm. Intern. l'Expl. Scient. Mer Méditerranée*, 8, n.s. 317 (Paris, 1934).

Organic Soils and Epinastic Response

CONSIDERABLE interest is being shown at the present time in plant auximones and the chemical regulation of plant growth. Traces of many substances have been found to influence growth profoundly. Such substances range from complex or as yet chemically unidentified bodies produced in the growing regions of plants to quite simple chemical substances produced by plant tissues or in the laboratory.

Among the latter is the gas ethylene which, when present in the air in amounts of the order of one part per million, produces characteristic effects on tomato, potato and other plants specially sensitive to it[1]. In the case of tomato, the most obvious reactions to traces of ethylene are: (1) stimulation of growth on the upper sides of petioles inducing characteristic epinastic curvatures, (2) stimulation of the formation of root primordia associated with inhibition of root growth—copious root growth occurring as soon as the treated plant is removed from the ethylene atmosphere. These reactions have been used to detect the presence of traces of ethylene and certain other gases, and it appears that the evolution of ethylene is a frequent accompaniment of plant metabolism, particularly during the ripening of many fruits[1].

In view of these facts it may be of interest to place on record some results of recent experiments of my own with certain infertile organic soils. Without entering into details, the following facts appear to be established. (1) A gas may be extracted from such soils (by aeration, centrifuging or heating) which produces on tomato plants epinastic curvatures of the petioles similar to those brought about by traces of ethylene. (2) Extracts from such soils when added to water culture solutions produce similar epinastic curvatures on cuttings and influence the rooting of cuttings and the manner of root growth of cuttings and seedlings. There are indications that the intensity of these effects is seasonal.

Comparison with soils of other types in relation to these effects is being carried out, and the results of the work will be published in due course.

In view of the known effects of gases such as ethylene in stimulating the formation of root initials and controlling the growth of roots, it seems not improbable that failure or success in the establishment of a root system on the part of seedlings in some soils may be influenced by the presence in the soil atmosphere of varying amounts of ethylene (or other gases producing similar reactions), the origin of which doubtless may be sought in the decomposition changes taking place in the organic constituents of the soil following upon biological activities.

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Sept. 17.

[1] Contributions from Boyce Thompson Institute, 7, 1935.

Points from Foregoing Letters

SIR JOSEPH LARMOR expresses his disapproval of the introduction of the new meter-kilogram-second system of units. He considers that the c.g.s. units, expressed in powers of ten, are adequate; he inquires, on the other hand, whether the Helmholtz system of electrical units may lead theorists astray.

Measurements of the ionisation in the F_2 layer of the upper atmosphere (at a height of about 300 km.), by means of radio-waves reflection, indicate that during magnetic storms there is often a reduction in the electronic content of the layer. Prof. E. V. Appleton and Miss L. J. Ingram suggest as a possible explanation that the agency responsible for magnetic disturbances heats and expands the atmosphere, thus reducing the electronic density.

Prof. J. Kaplan describes the experimental production of the light of the aurora and the night-sky by means of uncondensed electric discharges through nitrogen. Slight traces of hydrogen prevent the characteristic nitrogen afterglow with auroral spectrum. This fact, together with the absence of hydrogen lines in the spectra of the aurora and the night sky, suggests that hydrogen is absent in the upper atmospheres at the level where those phenomena occur.

Prof. Karl Pearson states that, in general, laws of Nature are neither true nor false, but merely more or less good 'fits' to our observations of Nature. He maintains that statisticians can only state that a hypothesis is false when the P, χ^2 square gives $P = 0$. As an example, he applies the P, χ^2 test to the data recently given by Sir James Jeans for the observed and calculated eccentricity of binary stars, and shows that the theory of equipartition gives a poor fit, if all the binaries are considered.

Contrary to Dr. Baker's view, J. van Zuylen considers that when making stereoscopic photographs the axes of the cameras can be either parallel or convergent to the object. The convergent method does give, however, a larger stereoscopic field of view. Dr. Baker admits that true stereoscopic views may be obtained with parallel cameras if the photographs are mounted so that corresponding points are nearer than the interpupillary distance; otherwise, as is usually the case, a wrong impression is conveyed.

Three new bands in the Raman spectrum of light scattered by heavy water are described by R. Ananthakrishnan, who infers that heavy water is polymerised in a similar way to ordinary water.

The velocity of diffusion of heavy into ordinary water has been measured by M. Temkin, and the diffusion constant is found to be of the usual order of magnitude, contrary to results previously announced by W. J. Orr and D. W. Thomson.

The antirachitic effect in chicken of vitamin D obtained from liver and body fat of various (mostly marine) animals has been compared by Dr. Ottar Rygh. No differences were observed between them.

Experiments with bats infected with *Trypanosoma equiperdum*, a parasitic organism causing venereal disease in horses, carried out by N. Kalabuchov and L. Levinson, show that if the animals are kept in ice boxes at 10° C. or 3° C. for 3–5 days immediately after the infection, the micro-organisms disappear from the blood and the animals recover. Infected controlled animals kept at ordinary temperature die within 9–13 days.

Prof. W. Neilson Jones records experiments pointing to the presence of chemical regulators of plant growth, such as ethylene, in certain organic soils. Such constituents of the soil atmosphere may exercise an important influence on the rapid acquirement of an effective root system on the part of seedlings.

Research Items

Culture Sequence in Nebraskan Archæology

MR. WILLIAM DUNCAN STRONG, in a survey of the archæology of Nebraska (*Smithsonian Misc. Collect.*, 94, 10) puts forward a chronological classification of the indigenous cultures of that state and of northern Colorado, in which the primary basis of division is historic, protohistoric and prehistoric. The evidence, apart from documents and European associations in the historic period, is based on the evidence from stratified sites or association with an extinct fauna or geological deposits of pre-recent date. The *Historic Period* covers the occupation by Pawnees, sedentary Sioux, Dakotas, Arapaho and Cheyennes. The Pawnees' occupation is the oldest known of these, extending back into the *Proto-historic Period* (1540–1682). This is the period of highest Pawnee cultural development. The *Prehistoric Period* (1541 back to an undefined past) in its latest phase is characterised by two main cultures, the Nebraskan and Upper Republican, which exhibit certain affinities, but at the same time appear to have maintained their integrity. The Nebraskan covers the area later occupied by the intrusive Siouan. The Upper Republican may be ancestral to the Pawnee, which would thus bridge the gap between historic and prehistoric. Stratigraphical evidence suggests that the Stern Creek culture is older than either Nebraskan or Upper Republican; but it may be an intrusive trans-Missourian culture. Of stratified sites, that at Signal Butte exhibits three phases, of which the third and last appears to be a sub-type of the Upper Republican. Phases ii and i have no pottery; but, throughout the three phases, the development of the projectile stone point, and in a lesser degree other stone implements such as the knife, can be followed in a cultural and chronological progression, which affords argument for linking Signal Butte I, though later, with the Folsom point and recent discoveries on the Lindenmeier site in northern Colorado (see p. 535 of this issue). At present, palæontological evidence is scant and the associations of implements with extinct fauna are culturally too meagre to afford ground for inference.

Stone Implements from South Australia

MR. WALTER HOWCHIN, who went to Australia in 1881 with an interest in prehistoric archæology inspired by association with Canon W. Greenwell, began to collect and study the stone implements of the extinct Adelaide tribe, which previously had been entirely neglected, in conditions which have now vanished. A paper prepared by him in 1893, but not then published in full, has now been completed and brought up to date ("The Stone Implements of the Adelaide Tribe of Aborigines now Extinct." By Walter Howchin. Gillingham and Co., Adelaide, South Australia. Pp. viii + 94. 7*s*. 6*d*.). The implements of the Adelaide tribe were found on the sand dunes of the coastal region near Adelaide and southward to the River Onkaparinga, the most prolific region being comprised within the ancient estuarine limits of the River Torrens. They occur in the recent drift, none having been found in the older formation of the sandhills. In one instance only, at Fulham, have they been found below marine deposits; but these implements must also be described as 'recent'. All stand in a different category from the stone implements of the tableland of Central Australia, with their characteristic desert glaze and ferruginous impregnation. The material most commonly employed for the Adelaide implements is quartzite; but various other rocks were in use, including even the intractable quartz. Flint appears sparingly, some of it being of European origin, imported as ballast. For certain implements, such as 'choppers', a volcanic rock, such as basalt, was employed. Characteristic forms are knives, falling into five classes, chisels, gouges and adzes, hatchets, scrapers (of which eleven varieties are distinguished), points, gravers, borers, etc., as well as a number of microlithic forms. Examples of the magical stones, which figure in aboriginal belief, some of curious form and unknown significance, are included in the collection. As a geologist, Mr. Howchin finds no evidence of a stone culture in any other than 'recent' conditions.

Life-History of the Organism of Pleuropneumonia

IN a former issue of NATURE (Feb. 24, 1934, p. 296), Dr. J. C. G. Ledingham's researches upon the causal micro-organism of pleuropneumonia of cattle were summarised. The matter has been carried a stage further by A. W. Turner (*J. Pathol. and Bacteriol.*, 41, No. 1, 1). He has studied the life-cycles and morphology of this organism in the living state by means of dark-ground observation of macro- and micro-cultures in a new fluid medium, which consists essentially of a peptic digest of ox liver and muscle, enriched with ox serum, and sterilised by filtration instead of by heat. The microbe is not filterable in the strict sense, though there is constant and early production of filter-passing forms ('conidioids'). It typically and constantly forms a relatively enormous branching mycelium, filaments of which may reach a length of 190 μ. It possesses at least five methods of reproduction, for which the term 'genethodes' is suggested. A new order Borrelomycetales to include it and the closely related organism of agalactia is proposed. The suggested terminology is *Borrelomyces* (nov. gen.) *peripneumoniæ*.

Morphology of the Wheat Joint-worm Gall

THE morphology of the stem galls produced on wheat by the chalcid wasp *Harmolita tritici* forms the subject of a paper by Messrs. W. J. Phillips and F. F. Dicke (*J. Agric. Res.*, 50, No 4; 1935). It appears that the female insect selects for oviposition the upper side of a node, in tissue that will later form an internode. The ovipositor is inserted slightly below the meristematic region, at the union of a leaf base with the stem. The egg is actually deposited in or near the phloem of the vascular bundle. The gall tissue arises partly from the phloem, but mainly from the parenchyma. There is no pith cavity in the part of the internode within the gall area, this section of the internode being filled with gall cells. Practically all the vascular tissue is destroyed in this region, and this inhibits the normal functions of the plant. The entire galled region lignifies and becomes hard by the time the larvæ are fully grown. The gall stimulus seems to be the products of larval

metabolism together with, perhaps, mechanical irritation. Unhatched eggs remain inert, a fact which strongly indicates that no stimulating substance is injected into the tissues at the time of oviposition to initiate gall-formation. The absence of the insect over the immense wheat area of Kansas and western Missouri seems to be due to the fact that the meristematic zone at the node of the wheat in this region is too tough and hard for oviposition. It is suggested that by fertilisation, or otherwise, the growth of the wheat might be brought to a stage unsuitable for the insect at the normal time of attack.

Refrigerated Gas Storage of Apples

LEAFLET No. 6 on Food Investigation, by Drs. Franklin Kidd and Cyril West, issued by the Department of Scientific and Industrial Research, 1935, shows how completely scientific investigation has now established suitable conditions for winter storage of the apple crop. It is now clear that if both the atmosphere surrounding the apples and the temperature are controlled, very adequate storage conditions can be provided when certain precautions are taken. Control of the atmosphere enables the oxygen supply to be cut down, and the carbon dioxide supply, released by the respiration of the apples, to be maintained at a suitable level. Whilst the slower respiration doubles the lifetime of the apples in store, the carbon dioxide has further influence in retaining the original green colour and hardness of the fruit. The temperature of the store is cooled as rapidly as possible to about 40° F. and kept about this level—too high for the development of the low-temperature breakdown conditions which so frequently follow when the fruit is released from stores at freezing temperatures. One of the most significant lessons learnt in recent years is the influence of the volatile products released from ripening fruit in producing further and deleterious changes in the fruit. They are controlled largely by their absorption by wrapping the fruit in paper soaked in mineral oil; it is also now clear that varieties with different ripening periods should be stored separately, as these substances are released in greatest quantity just as the apples begin to ripen. Practical details as to the construction and management of gas storage containers are given in this very concise publication.

Problems of Cacao Cultivation

1935 marks the close of the five year Cacao Research Scheme which has been carried out at the Imperial College of Tropical Agriculture, Trinidad, and a summarised account of the present situation has been published by Sir Geoffry Evans in *Tropical Agriculture*, 12. The work, financed jointly by the producers and manufacturers themselves, was launched as the first organised attack on the botanical and soil problems that arise in the cultivation of the crop. The aim of the botanical researches has been defined as "the collection of information necessary for improvement of both yield and quality", a uniformity of production, at least locally, being specially desirable. Improved yield will then justify intensive cultivation, which in its turn will be limited to the more productive areas. Selection and propagation studies have, therefore, been the chief lines of work, the development of good methods of vegetative propagation being of particular importance as only by this means can uniformity be obtained, cacao being subject to cross-pollination. As regards chemical and ecological researches, systematic studies of 'good' and 'bad' cacao soils have been made and detailed surveys of soils in representative cacao-growing districts carried out. From such investigations, it is now possible to state whether or not a particular soil will prove suitable for profitable cacao production, fluctuations in soil and atmospheric moisture being a factor of some importance. Further, manurial studies have shown that both the quantity and quality of the product may be greatly improved by the addition of suitable fertilisers. For a more detailed account of the scientific side of the work, reference should be made to the four annual reports on cacao research already issued and obtainable on application to the editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

Research at the Bose Research Institute

PAPERS recording the biological and physical researches, under the direction of Sir J. C. Bose, at the Bose Research Institute, Calcutta, have recently been published collectively ("Transactions of the Bose Research Institute, Calcutta", 9, 1933–34: Biological and Physical Researches. Edited by Sir Jagadis Chunder Bose. London, New York and Toronto: Longmans, Green and Co., Ltd., 1935. 18*s*. net). Further work on the physiology of *Mimosa pudica* has been carried out, during which the effect of flowering on diverse internal activities, especially of that of the pulvinus, were examined. The appearance of the inflorescence induces a depression in the moto-excitability of the pulvinus. This investigation, together with others, such as a study of variation in longitudinal and diametric growth in *Helianthus*, and the determination of the actual moment when germination commences inside a seed, together with the measurement of the rate of growth of the embryonic radicle, makes use of the continuous automatic record method which is so closely associated with the Bose Research Institute. By automatically recording the rate of oxygen consumed during respiration, a respirograph devised at the Institute is claimed to be very accurate and sensitive. This apparatus is fully described and illustrated. An investigation has been carried out on the physico-chemical and physiological nature of fat-soluble vitamins of *Cicer arietinum*, a pulse commonly used throughout India as an article of diet. The oil of certain varieties approaches cod liver oil in vitamin efficiency. Other researches at the Institute during the year under review include an anthropological study of the primitive Oraons of the Ramhi district, the continuous emission spectra of the hydrogen halides, and the flame spectrum of HCl.

Geology of Ceylon

So little has been published about the geology of Ceylon, that a monograph on the subject, accompanied by an excellent geological map, by J. S. Coates, who until recently was Government mineralogist of the Island, is particularly welcome (*Ceylon J. Sci.*, B, 19, 101–187; 1935). In order of age the formations described are as follows: Bintenne Gneisses are specially developed in the low country of the south-east. Khondalite series of granular quartzites and other metamorphic rocks, including garnet-sillimanite schists, form the central mountain system of the Island. Charnockites are extensively developed as sills in the Khondalite series and also occupy the whole of the south-western part of the

Island. There they are associated with garnetiferous leptynites that are regarded as sheared portions of charnockitic rocks. In the north and north-west a later series of Wanni Gneisses and granulites occur. The younger Pegmatites are of two types: a white variety (Balangoda group) remarkable for its variety of accessory minerals, including zircon and radioactive minerals; and a red variety poor in these accessories. Dykes of dolerite, peridotite and pyroxene-scapolite rocks also occur. Nine-tenths of the Island are occupied by the above crystalline rocks. The remaining deposits include the Jurassic Tabbowa Series; Miocene and related Tertiary beds; and Pleistocene and Recent coastal deposits and river alluvium, the last of which include the gem gravels for which Ceylon is famous. Gem-corundum has been traced only to the white pegmatites which are also the source of beryl, chrysoberyl, topaz, tourmaline and zircon. Moonstone occurs in bands of a sheared quartz-felspar rock probably related to the pegmatites.

Ionisation of the Upper Atmosphere

E. V. APPLETON and R. Naismith (*Proc. Roy. Soc.*, A, July) have published the results of a long, systematic investigation of the reflection of wireless waves in the ionosphere. The method employed is to vary the frequency of a wave sent upwards, and to plot automatically the delay time of the reflected wave observed at vertical incidence against the frequency. At critical frequencies, the wave breaks through a lower reflecting layer and is reflected at a higher one, and the critical frequency for a given layer is connected with the maximum electron concentration in the layer by a formula which is now well established. The investigation was mainly concerned with daytime conditions, which are more complicated than those observed at night, for instead of the simple E and F regions of ionisation there is frequently an intermediate region E_2 lying above E_1 and a region F_1 lying below the main F_2. The F_1 region is prominent only in summer. The seasonal variations of the noon values of ionisation in regions E and F_1 agree with a theoretical calculation based on the assumption that direct solar radiation is the ionising agent and recombination of ions the predominant dissipative process. The diurnal and seasonal variations of region F_2 are quite different, the critical frequency for summer noon being slightly less than for winter noon. The authors reject the conclusion of some of the American workers, that critical-frequency determinations do not give a true measure of the electron concentration; and explain their results on the assumption of a high molecular temperature for the upper atmosphere at summer noon. This causes a reduction in the electron concentration. The temperature required is of the order of 1,200° K., and could be due to molecular dissociation, or to collisions of excited molecules. The anomalies connected with region E are less fully considered, but examples are given of a special type of region E condition, common in summer, in which a thin stratum is formed which reflects strongly at both upper and lower surfaces, and which may give good reflection and hence very favourable transmission conditions for quite short waves.

Interaction of Neutrons with Matter

T. BJERGE and C. H. Westcott (*Proc. Roy. Soc.*, A, July) have investigated the production of 'slow' neutrons by the passage of neutrons through hydrogen-containing substances. Their main experiment consisted in surrounding a radioactive neutron source with cylindrical vessels of water of varying diameter, and measuring the artificial radioactivity induced in a specimen placed outside the vessel. The curves show a maximum effect for a thickness of water of about 10 cm., and further experiments show that the 'fast' neutrons coming from the source are reduced to half-value in about 7 cm. of water while the 'slow' ones only have a half-value distance of about 1·6 cm. The scattering cross-section of several atomic nuclei for 'slow' neutrons was estimated ($3 \cdot 10^{-23}$ cm.^{2} for hydrogen, 3×10^{-24} cm.^{2} for carbon and oxygen). The cross-section for absorption varies very much from element to element—it is about 4×10^{-25} cm.^{2} for oxygen and $1 \cdot 2 \times 10^{-21}$ cm.^{2} for boron. J. R. Dunning, G. B. Pegrum, G. A. Fink and D. P. Mitchell (*Phys. Rev.*, Aug. 1) have also studied these neutrons. Their results agree approximately with Bjerge and Westcott in giving a halving-distance in water for fast neutrons from a radon-beryllium source of about 8 cm., and a maximum production of slow neutrons by spheres of 10 cm. radius. These workers have also studied the production of slow neutrons in heavy water, and they find that it is about 5·5 times less effective than ordinary water. They conclude that there is a smaller probability of interaction between a neutron and a deutron than between a neutron and proton, and this is borne out by absorption experiments. The collision cross-section of a number of elements was measured for fast and for slow neutrons—the former shows a fairly regular increase with atomic number, while the latter varies violently from element to element, and attains a value 3×10^{-20} cm.^{2} for cadmium. The high absorption of cadmium for slow neutrons was found to be nearly exponential when measured with a parallel beam, and was also found to be a true absorption associated with very little scattering.

Structure of Keratin

ASTBURY and his co-workers have shown that the molecular structure of keratin is such that the 'extended' form β-keratin consists of flat grids of atomic chains bound together by side chains. A number of such grids piled on one another form the β-keratin crystallites, and a characteristic spacing of about 4½ A., found from the X-ray photographs of keratin structure, is supposed to represent the distance between the grids, while a spacing of 9½ A. represents the distance between main chains in the plane of the grid. In the normal unstretched α-keratin, the main chains are regularly folded in planes perpendicular to the grid. In a recent paper (W. T. Astbury and W. A. Sisson, *Proc. Roy. Soc.*, A, July 1), this view receives rather direct confirmation. Specimens of horns and hair were squeezed laterally in the presence of steam. The α-keratin was first changed to the β-form and the β-keratin crystallites then took up a definite orientation, X-ray examination now revealing directly that the 4½ A. spacing and 9½ A. spacing were respectively normal and parallel to the flat surface of the squeezed specimens. The sharpness of the X-ray diffraction spots shows that the keratin grids are not very wide, but that many of them are piled on top of one another to form the β-keratin crystallite. The end of the paper contains a short discussion of the evolution of fibrous proteins, and speculates on the condensation of these from the globular protein structures.

Association of Special Libraries and Information Bureaux

THE twelfth annual conference of the Association of Special Libraries and Information Bureaux, held at St. John's College, Cambridge, on September 20–23, was of more than usual interest to those concerned with the use and dissemination of scientific and technical information of all kinds. In his presidential address on "Interpretation of Science" Sir Richard Gregory referred to the neglect of scientific material to-day by writers of all kinds, as compared with writers of the nineteenth and earlier centuries. Science needs, he pointed out, not only writers to make its achievements intelligible to general readers, but also poetic and other interpreters who will expound its intent and influence by artistic representation or performance. Poetry, like other forms of art, should follow on the heels of knowledge, and Sir Richard quoted examples of the expression of observations of Nature and science in classical literary style, as well as of the poetic interpretation even of mechanised science. Literary genius has as yet rarely found inspiring themes in the great achievements of modern science, and, until this is done, the full appreciation of science and its achievements by mankind would be wanting.

This appeal for the creation of a new school of poets of science who employ their genius to interpret scientific truths with accuracy and genius was fully in harmony with the two major themes of the Conference. The first of these was a symposium on "Special Libraries and Their Problems", covering questions concerning the recruiting, training and future possibilities of special library staff. The discussion was opened by a paper by Mr. J. D. Cowley, on "Training for Special Library Work", who described the training given at the London University School of Librarianship, of which he is director, and the modification of its syllabus to overcome the practical difficulties experienced. Regarding librarianship as including "sympathetic and informed aid in the interpretation of material for study and research", the training aims at providing men and women who are not only trained in the technicalities of handling the material of research, but are also sufficiently informed in the subject of that material to interpret it and pass on the information gained in an acceptable form to others. The question whether training in librarianship should precede or follow training in research has yet to be decided, and some difference of opinion on this point was revealed in the subsequent discussion. Mr. Cowley's remarks about deficiencies in linguistic ability in graduates seeking admission to the course were endorsed in the subsequent discussion from experience in recruiting for information service. Mr. Cowley remarked that the School of Librarianship has so far failed to attract the really first-class science man.

Mr. Cowley's paper was followed by others on the "Functions of a Technical Information Bureau", by Dr. E. S. Hedges and Dr. C. E. Homer, who described the work of the Bureau of Technical Information of the International Tin Research and Development Council, and by Mr. F. H. Smith. Mr. B. Fullman, information officer of the British Non-Ferrous Metals Research Association, discussed "Information Work as a Career for the Scientist" and pointed out the possibilities in such work for a man of first-class training and originality. The success of information work and the rewards accruing from it are largely dependent on the personality of those engaged in it, and a similar view was expressed in a paper by Mr. T. M. Herbert, research manager of the London, Midland and Scottish Railway.

The second major theme of the Conference related to co-operation between industry and the public library services. Opening this discussion on September 22, Mr. R. Brightman, of Imperial Chemical Industries, Ltd., pointed out that the possibilities in this direction are only just beginning to be appreciated with the growth of special libraries in industry itself. The organisation of such internal library services is an essential preliminary to co-operation with external organisations, and Mr. Brightman then indicated some of the ways in which co-operation has already proved possible and further possibilities in which co-operation would lead to the more effective use of existing resources. Other constructive suggestions were made by Miss E. W. Parker, of the Mond Nickel Co., Ltd., in a review of the use made by industry and commerce of the public libraries in the London area, while Mr. J. P. Lamb described the progress of co-operation between local industries and the public library services in Sheffield. The value of personal contact between industry and the public librarian was emphasised both in these papers and in the discussion which followed.

Following on a paper on the new University Library on September 21, by Mr. H. C. Stanford, secretary of the library, members of the Conference visited the new University Library building. In the afternoon, Sir Stephen Gaselee gave a valuable paper on the "Libraries and Sources of Information in Government Departments", including descriptions or notes on the chief libraries represented in the 'Circle of State Librarians'. Sir Stephen Gaselee testified to the willingness of the Foreign Office library and other departmental libraries to deal with private inquiries, so far as facilities permit.

The annual report of the Council presented to the annual meeting indicated a slight increase in membership, but the necessity for an augmented income, if the work is to be developed adequately, was emphasised. Reference was made to the inauguration of a scheme for the issue of a quarterly list of recently published scientific and technical books, each book recommended by an expert qualified to judge the book in question. The list is intended mainly for the guidance of public and general librarians. During the year, a London and Home Counties branch was inaugurated, several meetings of which have already been held.

Other papers read before the Conference included one on reference books and their use, by Mr. B. M. Headicar, which dealt particularly with lesser-known books of this type, an account of the work of the Council for the Preservation of Business Archives by Mr. A. V. Judges, its hon. secretary, and an admirable analysis by Mr. R. S. Lambert of the response to information of all kinds supplied in the broadcasting services.

Possible Bearing of a Luminous Syllid on the Question of the Landfall of Columbus

By L. R. Crawshay, Marine Biological Association Laboratory, Plymouth

IN a paper by Lieut.-Comdr. R. T. Gould on the "Landfall of Columbus"[1] the author, after reviewing the whole subject, follows Murdock (1884) in placing the landfall at Watling's Island, the second island, Santa Maria de la Concepcion, being identified as Rum Cay, and the third, Fernandina, as Long Island, with Clarence Harbour as the harbour of entry on the east side of it. In the course of the discussion, he refers to the unexplained incident of the mysterious 'light' recorded by Columbus, as seen by him and others from the poop of the *Santa Maria* at about 10 p.m. on the night of October 11, 1492, "i.e., about four hours before making the landfall, and an hour before moonrise". The light was seen "some distance away in the darkness. It is described as looking like the flame of a small candle, alternately raised and lowered. It seems to have gone out of sight again not long after". The author proceeds: "Judging by the speed of the ships, as given in the journal for the night, the light must have been some 35 miles or so eastward of the landfall, and well to windward of it".

At such an estimated distance eastward of Watling's, the position of the light would be well out into the Atlantic, in some 3,000 fathoms of water, where the presence of a native canoe accounting for it, as suggested by Markham, seems inconceivable. Scarcely more credible is the view expressed by Mackenzie (1828), who makes the landfall at Cat Island, assuming the light to have been a shore light at Watling's, the island itself, however, being missed by Columbus in the darkness. Murdock disposed of the difficulty by the extreme course of suggesting that the light was non-existent and imaginary. Against the latter surmise is the definite record, not only of the light, but in such detail and in such circumstances as strongly to support the view that it was due to a surface display at the time of luminous marine annelids of the genus *Odontosyllis*.

In the case of *O. enopla*, Verrill, of which the habits and structure were described by Galloway and Welch[2], the times of the luminous displays, associated as they are with the reproductive process, appear to have some relationship with the lunar phases, and in one case observed definitely with the third phase, though the whole causes controlling the time of occurrence are somewhat obscure, with approaching dark and low tides apparently two chief contributing factors.

In the Bahamian species of *Odontosyllis*, frequently observed by me through past years, while engaged on the Sponge Fishery Investigations for the Colonial Office, the date of occurrence of the displays, though variable, was always closely associated with that of the moon's last quarter. In a single case, among seven definitely recorded occasions, a maximum interval amounting to about 3½ days was probably explainable by approaching disturbed weather, at the time occasioning premature appearance of the females at the surface. In other cases, the time was usually within about twenty-four hours of the moon's last quarter, the average being about eighteen hours. Examination of some preserved material remaining of this species, though at present undetermined, and possibly not yet described, shows it to be clearly distinct from the Bermudian species, and especially, among other features, in respect of its fusiform-clavate and articulated swimming setæ of the parapodia. Further, unlike the Bermudian species, as likewise also to some extent a British Honduras species, structurally similar to, if not identical with *O. enopla*, the time of appearance does not coincide with approaching dark, but may be long after darkness has closed in, the latest definitely recorded time being 8.30 p.m. The period of illumination is always very brief, usually not exceeding 5–10 minutes from first to last, and often so short as barely to allow time for a specimen to be captured. It may perhaps be repeated on a following night, but more usually will not recur until the same phase of a subsequent lunation. The illumination does not occur in all months, but has been definitely noted by me, between 1921 and 1923, in January, April, May, July, October and December.

The purpose of these luminous displays, in the species concerned, is wholly associated with the reproductive process. In his description of the swarming of *O. phosphorea*, Moore, observed by him at Nanaimo, British Columbia, Potts refers[3] to somewhat indiscriminate mixing of males and females, and the regularity of the times of mustering, and in increasing numbers, of both sexes, about half an hour before sunset. He expresses surprise concerning the difference of habit in *O. enopla*, in which the whole circumstances show a direct attraction of the males, through the illumination, by the females individually, for fertilisation of the ova as extruded. This is precisely what occurs in the Bahamian species. 'Swarms', strictly speaking, cannot be said to occur. But a varying number of mature females, ranging on occasions from perhaps half a dozen to twenty or so in a given location, will appear suddenly and almost simultaneously; a stream of brilliantly luminous matter is emitted by each one of them with the extruded ova, probably two or three times repeated at short intervals; and with this as a signal a number of males rush in, with short intermittent slight flashes, towards the light for fertilisation, partly with attachment to the female, partly darting rapidly to and fro through the luminous trail. Thus the whole process is concentrated within a brief interval of time, and more usually, as it seems, completed on one night, for a particular moon. This period of the lunar month is no doubt particularly favourable for the darkness it affords at a suitable time of day within a few hours after sunset. Whether directly influenced by the moon or not, it is very remarkable that, so far as I am aware, the displays on the part of the females never occur through the long and dark period immediately following the last quarter, or until the next lunation, which again may be missed until the same phase of a subsequent one.

With respect to the comparison of the light, in the journal of Columbus, with "the flame of a small candle alternately raised and lowered", and its disappearance soon after, the illuminating display of a single *Odontosyllis* female will at such times usually show this feature of separate short periods of excessive and declining brilliance, repeated two or three times over, or more. From the poop of the *Santa Maria*, it is easy to believe that this light would be visible on a dark night up to 200 yards, or even farther, away. As probably as not, the strange and unaccountable light would disappear almost as soon as there was time to report it.

As observed at Abaco, and within a limited area, the species concerned ordinarily frequents grounds of shallow water, and up to about 2 fathoms in depth, though probably extending much outside this. The displays, though variable in time, usually occur about the time of low water, or within an hour, or occasionally as much as 2½ hours, on either side of this. If the light was seen by the *Santa Maria* about 10 p.m. on the night of October 11, and the moon rose an hour later, as recorded, the moon was then presumably about one day before the last quarter. The time of low water, probably about 7.30–8.00 p.m., is comparatively unimportant, considering the variability in the time of appearance of the syllid in this respect. The latest time of display definitely noted by me in examples at Abaco was 8.30 p.m.

Murdock in his chart, followed by Lieut.-Comdr. Gould, shows the course of Columbus passing round the south side of Watling's Island. Mackenzie, who makes the landfall at Cat Island, shows it on the north side. In the latter case, there is a large shallow bank, with rocky heads, extending out for some 3½ miles from the present low-lying northern shore of the island; a position near the northern point of this bank, as shown in the chart of Mackenzie with indication of the position of the light, would leave little difficulty in explaining not only the presence of the Syllid as the source of the light, but also the passing of the island unobserved in the darkness at such a distance. At or near the extreme northerly point of this inner bank, there is little cause to doubt that the ships may have passed without striking or even sighting any submerged reef head, if then here existing.

As against the estimated distance of the position of the light at some thirty-five miles or so eastward of the landfall, and considering the frequent difficulty found in reconciling distances recorded with those existing between positions, as interpreted in the itinerary, it is on the whole a remarkable coincidence in the present connexion that the distance from the northern bank of Watling's to the south-east point of Cat Island is about 43 miles.

The primary purpose in the present discussion is to direct attention to a very probable explanation of the mysterious light observed on the night before the landfall was sighted, hitherto without any satisfactory explanation suggested, and thus leaving inevitably a weak point in the data employed for conclusions so reached regarding the identity of the landfall. The inference that it was Cat Island has its own difficulties, the greatest of these being, as it seems, its distance as recorded, about 18 miles, from the second island, while assuming the latter to have been Rum Cay. In any circumstances, I am unable to see how the incident of the recorded light can be regarded otherwise than as a point of evidence of first importance towards settlement of the problem.

[1] *Geographical J.*, May 1927.
[2] *Trans. Amer. Micro. Soc.*, 30, No. 1; 1911; republished in the *Con. Bermuda Biol. Sta.*, June 1916.
[3] *Proc. Camb. Phil. Soc.*, 17, Part 2, 1913.

National Water Resources

THE joint committee of Lords and Commons, appointed to consider and report on measures for the better conservation and organisation of water resources and supplies in England and Wales, held an inquiry during the month of July last, and completed it for the time being. The evidence given before the committee with a report of the proceedings, after being tabled in the Houses of Parliament, has been published*. The findings of the committee are set out in six resolutions, the first of which, affirming that the aggregate available supply of water is ample for all anticipated requirements of the country is, at least, reassuring, and should dispel whatever doubts (if any) have been entertained on this score; though it is little satisfaction to those who have experienced the serious inconveniences of the recent drought to know that, while locally there has been scarcity and restriction, elsewhere supplies have been plentiful and even running to waste.

The real crux of the situation is contained in the second resolution, which admits that a number of problems of distribution, compensation and similar matters are outstanding, and should be dealt with without delay. Taken in conjunction with the third finding, that sufficient material and experience is possessed by the Ministry of Health to enable the legislation necessary to deal with the problems to be drafted, there is a distinct implication that the Ministry of Health has been remiss in not coping with the difficulty before. Indeed, the main trend of examination by the committee of a departmental witness went to show that the former considered it was being called upon to discharge a duty which was superfluous, and the reason put forward by the secretary of the Ministry in support of the appointment of the committee was that it was for the purpose of getting the advice of an "impartial and competent" body on points of conflict which were known to exist, but which the Ministry, apparently, had made no direct effort to ascertain or define. Sir Arthur Samuel, a member of the joint committee, expressed himself pointedly if colloquially, when he asked Sir Arthur Robinson, "Are you not asking us to hold the baby for you and do the work which you yourselves ought to do, to shield you?"

It is scarcely surprising, therefore, that the remaining resolutions of the committee should call for the

* Joint Committee on Water Resources and Supplies (Session 1934–35). Vol I, Proceedings of the Committee, 2*d*. net, Vol II, Minutes of Evidence, together with an Appendix, 3*s*. 0*d*. net. (H.M. Stationery Office.)

preparation by the Ministry of Health of a preliminary memorandum on matters of controversy, to be circulated to all parties likely to be interested, in order to enable evidence in criticism to be heard after the recess, the committee feeling that, until the issue of such a memorandum, no useful purpose could be served by hearing further evidence on the subject-matter before them. The absence of any witnesses to speak on the industrial side of water user was, in fact, the outstanding feature of the inquiry, so far as it has gone, and it rather seems to indicate that trade and industry have been ignored by the Ministry in the prosecution of its plans. The unwisdom of such a step is surely obvious in connexion with "a question which raises interests very much wider than the interests of the Ministry of Health".

Road Width and Accidents

THE cause of road accidents is a topic which gravely concerns every class of the community, and each attempt to determine the degree to which any one factor operates in promoting road safety deserves general attention. From the point of view of safe driving, it is probable that there is an ideal width of road for each set of traffic conditions and that, at a certain traffic density, the division of the roadway into separate 'up' and 'down' tracks becomes advisable.

It is of interest, therefore, to read in *Roads and Streets* (Chicago, July 1935) a paper submitted to the Highway Research Board by Prof. R. L. Morrison, of the Department of Highway Engineering at the University of Michigan, entitled "Effect of Pavement Widths upon Accidents". The main object of the author's investigation was to find evidence bearing upon the desirability of building 20 ft. roadways instead of the smaller widths which had been adopted as adequate to allow of the passage of two vehicles. It is obviously difficult to make a rigid comparison in figures between any two roads, equal or unequal in size, and this is intensified by the uncertain data obtainable regarding many accidents, and by the absence of figures relating to minor unreported accidents which might yield valuable evidence.

In this investigation, several portions of roads are dealt with, and figures are given regarding (*a*) 34 miles of 20-ft. roadway and (*b*) 19 miles of 18-ft. width. After eliminating those unrelated to road width and found to occur at the rate of (*a*) 1·06 and (*b*) 0·90 accidents per mile, the author finds that those which are affected by road width occur at the rate of (*a*) 1·00 and (*b*) 1·70 per mile. This last figure on being adjusted in order to obtain a comparison on a common basis is increased to 2·20, but here the reasons given are not quite convincing, though they may be justified by a personal knowledge of the roads and their conditions. If, however, we take from the detailed analyses given in the paper the figures for accidents which can be accounted to grossly careless driving—the main cause of preventable accidents—the rates are (*a*) 0·53 and (*b*) 1·10.

These figures strikingly support the final comparison ratio deduced by the author, whose conclusion is that, on the grounds both of the accident rate and on the relative costs, of which figures are adduced, the 20-ft. roadway is justified. The author agrees that his data are not sufficiently extensive for general conclusions to be drawn, but suggests that the method of analysis might be adopted as a general approach to the problem. The figures dealt with are understood to relate to the accidents occurring in one year.

Biological Effects of Different Regions of the Spectrum

AT the red edge of the invisible in the spectrum there is a narrow band of light waves which have a powerful and hitherto unsuspected biological inhibitory effect. This is reported by Lewis H. Flint, of the Department of Agriculture, and E. D. McAlister, of the Smithsonian Institution (*Smithsonian Misc. Coll.*, 94, No. 5, June 24, 1935), as a result of further studies of the germination of dormant lettuce seeds when exposed to radiation.

Previous studies by Dr. Flint had demonstrated that such seeds could be made to germinate by exposure to red, orange and yellow light; and inhibited from germinating by irradiation with green, blue and violet light. The inhibitory effect was general for this upper end of the visible light spectrum, but reached its greatest intensity at wave-lengths of about 4200 and 4800 A. in the blue-green region.

The discovery of an inhibitory wave-band at the red end of the spectrum which, so far as the germination of lettuce seeds was concerned, was more powerful in its effects than the entire green-blue-violet end of the spectrum, came as a complete surprise. This band lies around the critical wave-length of 7600 A., at just about the point in the red where light ceases to be visible to the human eye.

Ordinarily its effect would be masked by the stimulating effect of the wave-lengths surrounding it, especially in sunlight. Perhaps fortunately for vegetation—although the inhibitory influence has been demonstrated only with lettuce seeds—the solar radiation in this neighbourhood is greatly reduced, owing, it is believed, to its absorption partly by oxygen in the atmosphere of the sun and partly by water-vapour in the atmosphere of the earth. Notwithstanding this absorption, however, the energy of solar radiation at this point is large.

Further studies of the possible effectiveness of this region in respect to the germination of other seeds and in respect to other phases of light sensitivity are now in progress.

Educational Topics and Events

ABERDEEN.—The King has been pleased, on the recommendation of the Secretary of State for Scotland, to approve the appointment of Prof. E. W. Henderson Cruickshank, professor of physiology in Dalhousie University, Halifax, Nova Scotia, to be regius professor of physiology in the University of Aberdeen, in succession to the late Prof. J. J. R. Macleod.

FOR London school-teachers, the London County Council offers an extensive and attractive programme of winter evening lectures and classes designed to bring them into touch with the latest developments in educational methods and to give them opportunities of hearing leading authorities in various branches of learning and on current questions of public importance. A glance through the recently issued handbook for the session 1935–36, giving full particulars of nearly a hundred items, leaves the impression that this scheme, which is self-supporting and obtained last year 13,000 entries, cannot fail to raise the standard of liveliness of school teaching in the metropolis. Of the courses grouped under the heading Science, nearly all deal wholly or in part with the science of life. They include a Saturday morning series at the Zoological Gardens on "Animals at the Zoo", lecture-demonstrations at the London School of Hygiene on "Fundamentals of Biology", a series on the conduct in the school of observations and experiments on plant and animal life, lectures on food and food values, on the teaching of hygiene and on science for senior schools. The last-mentioned course will direct attention to the desirability of framing science syllabuses on a wider basis than that traditionally employed, and will include an exposition of schemes of work which have been found suitable for senior children of both sexes in a London school.

SECONDARY schooling for all is an ideal towards the realisation of which the United States has made notable advances. That the ideal is a mischievous one, and that advances towards it have had devastating results, is the gist of a lively diatribe by one of the staff of a Pennsylvanian High School published in *School and Society* of April 13. The public school is declared to have become, to a large extent, a "racket". A large proportion of the students who are promoted willy-nilly into the secondary schools will not and cannot profit by further schooling in any form. This is the opinion not only of teachers of academic subjects but also, emphatically, of shop teachers, whose energies are largely devoted to making the best of the subnormal pupils for whose benefit money is lavished on special apparatus, special textbooks and individually supervised study. If the material is thus unpromising, the quality of the staff available for processing it suffers from the dominance of the doctrinaire in the direction of the teacher training institutions. Here students are being compelled to spend so much of their time learning how to teach that they have little left for mastering the subject matter they are to handle. They are bewildered by the multitude of their courses, many of them obscured with metaphysical subtleties; and they are practically obliged to accumulate further 'credits' by attending vacation courses remote from utilitarian or cultural values.

Science News a Century Ago

London and Edinburgh Philosophical Journal

THE contents of the October, 1835, number of the *London and Edinburgh Philosophical Journal* consisted mainly of reprints of papers read before various societies. These included one by Sir David Brewster on the structure and origin of the diamond, one by Apjohn on a formula for inferring the dew-point from the indications of the wet-bulb hygrometer, a part of C. B. Rose's sketch of the geology of West Norfolk and a paper by Encke on Olber's method of determining the orbits of comets. There was an original communication from C. L. C. Rumker (1788–1862), the director of Hamburg observatory who had served in the British Navy, to Sir Thomas Brisbane on a new method of reducing lunar observations for the determination of the longitude. The number, however, was of more than special interest as it included the first of a series of official reports communicated by the Council and Secretaries of the British Association on the Dublin meeting.

The Entomological Society

AT a meeting of the Entomological Society, held on October 5, 1835, "Various donations of entomological works were announced, including the first number of the splendid 'Fauna Japonica' by Drs. Siebold and De Haan, presented by the authors. Various new members were elected, including Count De Jean and M. Boisduval, of Paris. A communication was received from Mr. E. Doubleday, containing an account of the total destruction of a beehive by a small moth, *Galleria cereana*, the larvæ of which had completely devoured the comb—portions of which were exhibited. Several living cane plants, greatly infested by the cane fly, were exhibited by Mr. J. C. Johnstone, by whom an account was given of the rapid and alarming progress of this minute insect, its ravages extending over two-thirds of the island of Grenada, to so great an extent that plantations which originally made 300 hogsheads did not now make more than eighty or ninety. . . ." (*Athenaeum.*)

Sir Charles Bell at the Middlesex Hospital

ON October 7, 1835, Sir Charles Bell wrote to his brother George, "I don't think I have written to you since I began the lectures, establishing a school in the old Middlesex. At least my spirit and devotion to the art and to the institution to which I am attached will not be denied. I have delivered six lectures, such as only long experience and study could have produced. I lecture to some sixty pupils —which for a beginning is as much as we could expect. N.B.—I have received not one guinea from these lectures and expect none. On the contrary I have subscribed £50 as one of the hospital surgeons, £30 as a lecturer. Nevertheless, the main object will be gained—the preserving the hospital respectable. . . . I now return to the cheap and complete edition of my 'Nervous System'."

The Tortoises of the Galapagos Archipelago

ON October 8, 1835, Darwin records: "We arrived at James Island; this island as well as Charles Island, were long since thus named after our kings of the Stuart line. Mr. Bynoe, myself, and our servants were left here for a week, with provisions and a tent,

whilst the *Beagle* went for water. We found here a party of Spaniards, who had been sent from Charles Island to dry fish and to salt tortoise-meat. About six miles inland, and at the height of nearly 2,000 feet, a hovel had been built in which two men lived who were employed in catching tortoises, whilst the others were fishing on the coast. I paid this party two visits and slept there one night. . . . While staying in the upper region we lived entirely on tortoise-meat: the breastplate roasted (as the Gauchos do *carne con cuero*), with the flesh on it, is very good; and the young tortoises make excellent soup; but otherwise the meat to my taste is indifferent."

Societies and Academies

PARIS

Academy of Sciences, August 12 (*C.R.*, 201, 413–436). The President announced the death of Antoine Guntz, *Correspondant* for the Section of Chemistry. HANS SCHWERDTFEGER: Functions of matrices. BORIS KAUFMANN: The infinitesimal properties of closed ensembles of arbitrary dimension. RICHARD BRAUER: The integral invariants of varieties representative of simple closed Lie groups. GEORGES BOURION: The limit functions of the partial sums of an integral series at the frontier of the circle of convergence. MARCUS BRUTZCUS: The appreciation, *a priori*, of the value of a commercial combustible for motors. RENÉ DUBRISAY: The action of sulphur on silver. The blackening of silver can be produced by sulphur without the intervention of a sulphur compound. The increase in the rapidity of the action caused by a high vacuum may be partly due to the increased rate of diffusion of the sulphur vapour, and partly to the removal of a layer of protective gases on the silver. JEAN CALVET, JEAN J. TRILLAT and MILOSLAV PAIĆ: The recrystallisation of pure aluminium. Application of the X-ray method to the study of the velocity of crystallisation of aluminium containing 99·9986 per cent of the metal. At 0° C., slight traces of crystallisation appear after 12 hours, and this is still incomplete after 336 hours. At 100° C., recrystallisation is complete after one minute, and at higher temperatures is practically instantaneous. CHARLES DUFRAISSE and MARCEL GÉRARD: Dissociable organic oxides and the anthracene structure. The existence of a photo-oxide of anthracene: its thermal decomposition. According to the theory developed from the study of the rubenes, anthracene should absorb oxygen rapidly under the action of light, forming a compound decomposing on heating but without emitting oxygen. The results of experiments with anthracene are given, fully confirming these views. RENÉ SALGUES: Erythrocytes, hæmoglobin and the globular value in the course of cancerous affections in birds. LÉON VELLUZ: The comparative action of the bile acids on the tetanus and diphtheria toxins: the special properties of lithocholic acid. For the same polycyclic structure, the neutralisation of the diphtheria toxin depends on the number of alcohol groups, whilst this substitution is without influence on the neutralisation of the tetanus toxin. Lithocholic acid is the most energetic agent known as regards neutralisation of the toxin of diphtheria. RAYMOND-HAMET: The non-modification of the sympathicolytic activity of yohimbine by the introduction of a double bond in the molecule of this alkaloid.

August 19 (*C.R.*, 201, 437–460). LOUIS BLARINGHEM: The fertility of *Hemerocallis flava* and of its hybrid (*H. flava* × *H. fulva*). HARALD CRAMÉR: The asymptotic properties of a class of chance variables. G. PÓLYA: Integral series satisfying an algebraic differential equation. PIERRE LEJAY and TSAN HUNG CHI: Gravity map of the south-west of China. REZA RADMANÈCHE: Influence of temperature on the electrical conductivity of quartz. PHILIPPE WAGUET: Light emission of mercury arcs under high pressure. From measurements with a photoelectric cell of the light intensities of a mercury arc at varying incidences it is concluded that the colour of the mercury arc varies according to the direction from which it is observed. This complicates the problem of heterochrome photometry when the mercury arc is used as a light source. GEORGES FLUSIN and CHRISTIAN AALL: The study of the system calcium carbide, calcium oxide. G. DEDEBANT, PH. SCHERESCHEWSKY and PH. WEHRLÉ: The theory of the general circulation of the atmosphere. The law of the rotation and the field of pressure. FERNAND ARLOING, ALBERT MOREL and ANDRÉ JOSSERAND: The action on tumours, in intravenous injections, of soluble chemical products in which iron is associated with vitamin C (ascorbic acid).

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 9, 1935). L. G. MAGNARADZE: The problem of the elastic oscillation of the semiplane. G. M. BAVLI: A generalisation of the boundary problem of Poisson. N. A. SLIOSKIN: Discontinued two-dimensional movement of an ideal gas round a curved obstacle. N. A. DOBROTIN: Distribution in angle of protons projected by neutrons. M. DIVILKOVSKIJ and M. FILIPPOV: Measurement of the intensity of magnetic fields of very high frequency. W. FRÉDERICKS and V. ZVETKOV: Orientating action of an electric field on the molecules of anisotropic fluids. M. P. VOLAROVITCH and A. A. LEONTJEVA: (1) Determination of the specific volume of molten diabase at high temperatures. (2) Determinations of the specific volume of molten salts at high temperatures. P. P. PORFIROV: Determination of the capacity of a polarised mercury electrode. N. P. SMIRNOV: The stimulus to precipitation. N. N. VOROZHCOV, Jun. and A. T. TROSCHENKO: Morphine content in the latex of *Papaver somniferum*. A. E. FERSMAN: The *ek* system (see NATURE of August 31, p. 349). S. N. SIMAKOV, N. A. SCHWEMBERGER and O. S. VJALOV: Silurian naphtha in central Asia. N. A. SCHWEMBERGER: Contribution to the problem of the silurian naphtha in Central Asia. M. N. IVANTISHIN: Contribution to the problem of the geochemical zonation in the distribution of metallic elements on the territory of the Far Eastern region. A. G. EBERZIN: The Tchauda layers in the Taman peninsula. O. NIKIFOROVA: The Upper Silurian of Podolia. S. F. CEREVITINOV and L. V. METLICKIJ: Effect of an electric field of high frequency on the keeping qualities of fruit and vegetables. A. V. POPOOV: Note on secondary dormancy of *Taraxacum megalorhizon* seeds. T. S. RASS: Some regularities in the structure of eggs and larvæ of fishes in northern seas.

(*C.R.*, 3, No. 1, 1935). I. M. VINOGRADOW: Some rational approximations. I. D. ADO: Representation of Lieschen groups by linear substitution. S. TCHUNIKHIN: A generalisation of the theorems

of G. Frobenius and of V. Turkin. A. P. DIETZMANN and A. A. KULAKOV: Some criteria of non-simplicity of finite groups. W. FEDOROV: Uniform functions. S. SHUBIN: Application of the method of the Dirac density matrix to the theory of metals. G. LIANDRAT: Utilisation of a selenium photo-element for the measurement of the ultra-violet solar radiation in the region of 3200 A. A. M. STEFANOVSKIJ, E. S. TATARSKIJ and N. V. ZELIAKOV: Dependence of the structure of ammonia catalyser upon the conditions of its reduction. V. G. FESENKOV: Photometric analysis of the luminosity of the night sky. N. S. FILIPPOVA: Isotopes of hydrogen in petroleum. P. LAZAREV: Ionic theory of the physiological action of short waves. A. N. PARSHIN: Extracts from the muscle tissue of dog and rabbit. V. P. NEKHOROSHEV: A find of Upper Palæozoic marine deposits in the Zaisan basin. M. E. NEUHAUS: Data concerning crossing-over between the X and Y chromosomes in females of *Drosophila melanogaster*. B. K. STEGMANN: Distribution and geographical variation of *Saxicola torquata*.

ROME

Royal National Academy of the Lincei, April 28. G. ROVERETO: The Montenotte series as a constituent element of the Western Alps and of the Apennines. M. RENATA FABBRI: Differentials of higher order. L. ROTH: The regularity of algebraic surfaces. E. CIANI: A sizigetic bundle of cubic surfaces (1). A. DE MIRA FERNANDES: Compound tensorial derivation in non-point spaces. TH. MOTZKIN: Some characteristic properties of convex ensembles. N. W. AKIMOFF: Considerations on propulsive efficiency. C. TOLOTTI: Typical case of dynamic universes endowed with complete symmetry about a centre. The field-equations of a universe showing complete symmetry about a point have been derived previously, the only hypothesis made being the existence of suitable co-ordinates with respect to which the propagation of light is isotropic. Further assumptions now made are that such isotropy holds with respect to substantial co-ordinates (connected with the moving matter) and that, in such co-ordinates, the velocity of light is independent of position. Under these conditions, the gravitational equations are shown to relate necessarily to a completely homogeneous universe. G. PICCARDI: The atmospheres of the planets. A hypothesis is advanced to explain the fact that the atmospheres of the planets near the sun are characterised by oxygen compounds and those of the more distant planets by carbon-hydrogen compounds. T. FRANZINI: The diffusibility of deuterium into metals. The displaceability of occluded hydrogen by an electric field is confirmed, and the absence of a similar effect with deuterium is shown. Further work is necessary to decide whether deuterium is adsorbed, but not absorbed, by palladium; or neither adsorbed nor absorbed; or absorbed, but not displaceable. R. MANZONI ANSIDEI: The Raman spectra of the isomeric nitrotoluenes. The measurements made confirm those published by Kohlrausch, Dadieu and Jele in 1931. G. PICCARDI: (1) The spectrum of neodymium oxide vapour. (2) The spectrum of samarium oxide vapour. C. ACQUA: The nature of ultra-viruses. From a review of the evidence available, the conclusion is drawn that filterable viruses have an auto-catalytic action. A. MESSERI: The organising power of wood and of the primary phloem.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 507–516, August). E. C. MACDOWELL, M. J. TAYLOR and J. S. POTTER: The dependence of protection against a transplantable mouse leukæmia upon the genetic constitution of the immunising tissue. Two strains of mice were used. Embryonic tissue from one strain induced resistance in all cases; that from the other failed to induce resistance in its own strain; embryonic tissue of hybrids of the two strains are as successful as the first. J. W. ALEXANDER: (1) On the chains of a complex and their duals. (2) On the ring of a compact metric space. ALFRED J. MARIA and ROBERT S. MARTIN: On the representation of positive harmonic functions. M. H. ELLIOTT and W. C. TREAT: Hunger-contractions and rate of conditioning. Hunger-contractions, visible in rats with stomachs transplanted to a position just below the skin, were found to coincide with periods of activity. Rats with such hunger-contractions were able to learn to respond to a conditioned stimulus (an electric light) more quickly than animals which had received food.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, October 6

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J Edwards: "Animals and Man" *

Monday, October 7

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—J. Ramsbottom: "Fungi and their Mode of Life".*

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research: Food Investigation. Leaflet No. 6: The Refrigerated Gas-Storage of Apples. By Dr. Franklin Kidd and Dr. Cyril West. Pp. 12. (London: H.M. Stationery Office.)

Sixteenth Annual Report of the Ministry of Health, 1934–35. (Cmd. 4978.) Pp. xii+350. (London: H.M. Stationery Office.) 5s. 6d. net.

Transactions of the Royal Society of Edinburgh Vol. 58, Part 2, No. 17: The Endodermis in Light-grown and Etiolated Shoots of the Leguminosæ—A Contribution to the Causal Study of Differentiation in the Plant. By Dr. G. Bond. Pp. 409–425+1 plate. 2s. 6d. Vol. 58, Part 2, No. 18: Rare and New Ostracoderm Fishes from the Downtonian of Shropshire. By Prof. Leonard J. Wills. Pp. 427–447+7 plates. 5s. (Edinburgh: Robert Grant and Son; London. Williams and Norgate, Ltd.)

Other Countries

Veroffentlichungen des Geophysikalischen Instituts der Universitat Leipzig. Serie 2: Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium. Band 6, Heft 3: Temperaturverhältnisse und Windsystem eines geschlossenen Waldgebietes. Von Horst Gunther Koch. Pp. 121–175+2 plates. Band 6, Heft 4: Die physikalische Arbeitsweise des Gallenkamp-Verdunstungsmessers und seine Anwendung auf mikroklimatische Fragen. Von Katharina Dorffel. Pp. 177–222. Band 6, Heft 5: Instabile Schichtungen der Atmosphäre und Ihre Bedeutung fur die Wetterentwicklung im Koningsberger Gebiet. Von Gerhard Seifert. Pp. 223–379+34 plates. (Leipzig: Geophysikalisches Institut der Universität.)

Zakład Astronomji Praktycznej Politechniki Warszawskiej (Institut d'Astronomie pratique de l'École polytechnique de Varsovie). Publication No. 13: Pomiary mikrofotometryczne gwiazdy zmiennej SU Draconis w latach 1931–1934 (Mikrophotometrische Messungen des veranderlichen SU Draconis in den Jahren 1931–1934). Napisali F. Kępiński i M. Kowalczewski. Pp. 18. (Warszawa: Politechniki Warszawskiej.)

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 13. Pp. iii+144. (Paris: Les Presses universitaires de France.)

Report on the Zoological Survey of India for the Years 1932 to 1935. Pp. iii+lx. (Delhi: Manager of Publications.) 1.2 rupees; 2s.

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3441 SATURDAY, OCTOBER 12, 1935 Vol. 136

Food, Farmer and Future

"Considering *Punch* as the expression of the popular voice . . . is it not also surely some overruling power in the nature of things, quite other than the desire of his readers, which compels him, when the squire, the colonel and the admiral are to be at once expressed, together with all that they legislate or fight for, in the symbolic figure of the nation, to represent the incarnate John Bull always as a farmer—never as a manufacturer or shopkeeper and to conceive and exhibit him rather as paymaster for the faults of his neighbours, than as watching for opportunity to gain out of their follies."—John Ruskin. Lecture at Oxford. Nov. 1883. (Cook and Wedderburn ed. Vol. 33, p. 365.)

SIGNS are everywhere to-day that the desire is growing in us to put the house social more under considered control: we see that the happy-go-lucky individualism of the past must give way to a well-thought-out system, which will be to the greater good of a greater number; we see the need to infuse a greater share of human sympathy into commerce and industry, in place of the unbridled spirit of competition that has too long prevailed: in other words, there is an obvious desire to introduce scientific practice into our affairs, so that we may work with calculated effect.

Life is so complex that we have forgotten how entirely food is its foundation and mainstay. We have taken what is provided as a matter of course, with little thought for the stomach: too easily assuming that nothing unwholesome would be offered, scant allowance has been made for commercial greed. The use of crude fuels, such as coal and oil, has led us to overlook our own need of carefully chosen fuels of altogether special quality: in fact, twenty years ago, when the War began, we had but a few rough rules to guide us. The rapidly growing science of dietetics has been developed almost entirely since the War. We now know that Nature exerts her control by homœopathic means: that our gross foods are assimilated under the influence of indispensable very small proportions of a large number of accessory agents, in balance, each of which apparently serves the special ends of some one or other of the many separate, departmental activities of the human system. A trace of iodine may shift the balance from idiocy to sanity. No factory is in any way an approach to our bodies in complexity and perfection of organisation. Not a few of us look forward with comfortable assurance to a time when present-day curative medicine will give way to a preventive medicine which will all but insure health, through proper feeding. An Erewhonian situation will then prevail: disease will be punishable—because it will be admitted that it is mainly due to misfeeding and malnutrition.

Once established, this attitude towards health must affect our policy in every direction. In asking for a national stock-taking, Mr. Lloyd George has shown that he already has a dim notion of the coming state of affairs—when official ignorance will be overcome by constructive knowledge, broadly spread throughout the community, not localised in a bureaucratic service. We have to define an agricultural policy without further delay.

Milk will be our mainstay and primary care, being Nature's ideal food, the food of infancy. As a nation, we have yet to recognise the general value of milk; that the Milk Marketing Board should feel called upon to press it upon the attention of the medical profession, by a weekly advertisement in the *Lancet*, is not merely farcical but little short of a tragedy. We have to create a milk conscience in all concerned with its production. Proper conditions of cow-keeping must be enforced, throughout the country; we must not allow the trade to be in ignorant hands. If rigid count can be kept of publicans, control of dairymen should not be impossible. Maybe, if it

were taxed, as dear as beer, milk would be more valued and more popular. Everything has yet to be learnt about milk. Certain deficiencies are to be recognised even in the best product. Whether these are innate or the consequence of long continued malnutrition, due to exhaustion of our soils, is a question.

If cows came "from out the East", originally they will have been exposed to a fuller measure of sunlight than are our cows to-day; if so, their output of the much belauded D advitant may have been greater, particularly if better feeding put more ergot-sterol into the hides of the Eden herd. Eve, noticing that the animals generally ate it, may have been led to give a bite of grass or of some water weed to her infants with her milk; civilisation has made modern mothers less considerate, though I hear of my Californian great-grandson being given spinach from early infancy. In fact, we do not yet know what milk is, might be or should be. A vast field of scientifically directed, experimental inquiry lies open—real inquiry, not randomised re-search.

The inquiry into milk will involve no mere study of milk but also of the animals producing it and of the foods from which it is made. We may say already, that we know—some few of us feel it in our bones—that, like ourselves, when properly fed, cattle will be free from disease. Grass hitherto has scarcely been a cultivated crop—we have to study its cultivation, under the various conditions of soil and climate which prevail in our islands; this applies equally to other crops used in feeding farm animals. Milk will surely be found to vary in quality—eventually the districts producing it will be graded and specially named, as vineyards are in France and Germany: *Liebfraumilch* will not be the only brand: *Milch, Weib und Gesang* will be our modern *Sprichwort*. Our Wine and Food Society will have its milk tasters who will vie with Mr. André Simon as a wine taster; a Marcel Boulestin–Ambrose Heath combine will act as grass tasters to cow herds, as well as in testing our salads.

A problem to be inquired into is the cyclic variation with the year in grass and other green foods supplied to cattle. The plant must change its character in passing up to the climax of its growth and thence down to maturity. Milk must be correspondingly affected. At present, all that we know is, that some of the shortcomings in winter food may be met by rationing cattle with summer-grown grass, cut young and immediately dried with special care. In an experiment which I was instrumental in starting at Christ's Hospital winters ago, six cows out of a herd of thi were fed with such grass, grown, cut and under the superintendence of Sir Frederick I at the Jealotts' Hill Farm of Imperial Ch Industries, Ltd. Throughout the winter, remained sleek and gave a milk of summe acter, whilst the rest of the herd fell off as giving an ordinary poor winter milk. S results have since been obtained elsewhere may hope that, some day, winter conditior be overcome by justifying the practice Laputan philosophers.

To produce grass of the right quality, the ing plant must be sprayed with water an with fertilising solutions, at the expedient m The supply of water, therefore, must be tak account and due provision made. Ultima will be found that only certain districts ar able for the production of a standard ar these will be definitely earmarked for the p and supply regulated to meet the demand.

In connexion with milk, butter and chee need special consideration—to what extent to supply ourselves with these. We are supplied now that the public is losing all s quality in cheese—the gullible housewife wi anything, provided it be in wedges wrapped foil, paying through the nose for it. Each should have a cream cheese of note: dair generally should be called upon to show tha have the imagination to produce distinctive a of what use are the bacteriologists if they provide each county with its special chee to be brandished against all comers from ou

Our milk production should be strictly cor with and regulate our output of meat—o beef and pork, even of poultry and eggs. involves butter-milk and its use in pig and p keeping: not an ounce should be wasted. Rothamsted should spend time and money in ing how it may be made harmless before t it into a stream is nothing short of crimin donation of manufacturers' ignorance. V milk a dainty dish to set before king and n

Sugar may come next. We shall have t this seriously, not as mere sweetness. In it can only be produced at an economic lo has always been bounty fed. It may hav cultural advantages and suit our farmers present conditions—but Peter is robbed Paul, the community bears the brunt. Sug be made from sugar cane, at half the c

beet sugar, in the West Indies, Java, etc. We cannot but purchase some foreign goods in exchange for our manufactured goods—is not sugar one of the articles we should agree *to purchase*, on this account? There is no question of sweated labour to be considered: sunlight and the associated conditions in tropical countries all prevail against the economic cultivation of sugar here.

Maybe we shall soon be led to discourage the consumption of sugar and reduce its use to a minimum. Evidence is accumulating that it is an undesirable, if not a bad food, except when used to meet the strain of extreme muscular exertion, as in racing or climbing. The rise in the consumption of sugar, in modern times, is remarkable, especially in the United States; coincidently, there has been a marked fall in the amount of bread eaten. Americans are directing attention to a surprising change in national type—to the growth of obesity and even flabbiness in character. Are we not also losing character and becoming sugary in outlook? Sugar definitely spares fat—women are right in avoiding it, on this account. Worst of all, we starve ourselves in eating sugar in any quantity: it carries nothing with it—no mineral matter, nothing that is body-building. On this account it is bad for children. Finally, it is probable that resistance of infectious disease is lowered by an excess of sugar in the blood.

Follows bread. Society has a heavy indictment to bring against the medical profession in particular, in that it has so long allowed the use of white wheaten flour as bread—that it has not insisted on as much as possible of the whole grain being eaten. The faults of white flour are those of sugar—it is mainly of use as fuel and has little nutritive value. It is truly a whited sepulchre! Nearly the whole of the mineral matter and the vital components—the germ—are removed in the bran, which is not eaten but sold as offal, for use by animals; these get the best of the bargain. The use of such flour is traceable to American laziness, to the desire to avoid hard labour by the use of machinery, also the desire to do big business and supply the world—without counting the loss to American soil or European farmers. Wholemeal flour cannot be kept more than a few weeks, as the oil in the germ becomes rancid; white flour, being free from the germ, may be stored over long periods—it therefore suits the milling and baking trades. Canadian hard wheats have also an unfair advantage, in that the flour will carry more water: the baker can make more loaves from the sackful. Bread to-day is made *en bloc*—by machine: it is crustless and uninviting, as well as of minimum nutritive value. We need to go back to the local mill and the local baker—who together can give us a seemly loaf, of a bread containing as much of the cereal grain as may be eaten profitably. Maybe as good, if not better, breads may be made from home-grown than from imported wheats—putting aside all question of their water-carrying power.

Although Rothamsted has grown wheat on the same land, under like conditions, during more than ninety years, with great show of statistics, nothing has been learnt of the nutritive value of the grain. In any case, not a sack of flour should be allowed to come into the country—only grain, to be ground here. Our present fiscal policy will need drastic revision, if our knowledge of food be allowed to play any part in determining its character and scope. So will our agricultural research.

Last, but not least, "'tis but the means to do ill deeds that makes deeds ill done". This applies equally to the good deed of growing high quality crops: to water and manures, without which, in due season, nothing is possible. Agriculture has two great problems to consider—that of water-supply and that of waste-disposal. Neither can be discussed here. Suffice it to say, we cannot afford, any longer, *to waste organic matter*: we must have humus manures, if we are to put quality into agricultural produce, especially into table vegetables. All town waste must be collected and specially treated: Sir Albert Howard and others, working in India, have shown how this can be accomplished. Our people will perish, not from lack of knowledge but of organic manure, if this be not soon done. In addition, we cannot any longer allow sewage to go to sea: we must in some way recover from it both potash and phosphate, of which the natural stores are very limited. China calls to us, offering an example of thriftiness that we shall be compelled to follow. Our agricultural research stations fail us, not only in this particular but generally in matters of food production. They offer us only bare figures. Man unfortunately lives not by statistics.

A great renascence awaits us. We have to brush the pedant aside and make our universities of avail in the service of the nation. Education at the present day is worthless for all practical purposes; its fulcrum, in future, must be the belly through favour of the farmer.

HENRY E. ARMSTRONG.

Stability of Structures*

By J. S. Wilson

THE meaning of stability is not easy to define. In dynamics and mechanics we have stability of steady motion and stability of equilibrium, of position and of friction. To the civil engineer the word is usually applied to the power of a structure to withstand for an indefinite time all the loads and forces that may be brought to bear on it.

The most stable structure ever built is probably the Great Pyramid of Egypt. It consists of large blocks of limestone carefully shaped and piled together to the height of 480 ft. on a base measuring 830 ft. square. Another example of a great pile: a pile of bricks laid one on another, was a tall chimney such as the celebrated one at St. Rollox in Glasgow. This had a height of 435 ft., and at its base a diameter of 40 ft. It was pulled down a few years ago after having stood since 1842. A masonry dam built across a valley to impound water is a form of structure the stability of which must be beyond question, as failure would lead to disastrous flooding. Then we have the arch, the most beautiful and fascinating form of construction invented by man. In its simple form we have arches of imposing size and graceful stability across rivers, while in cathedrals and other great buildings we have it in the groin, dome and buttress.

In each of these examples, strength and stability depend mainly on the resistance to compression offered by stone or brick. A complementary form of structure, dependent on the resistance to rupture by the pulling asunder of its parts, is the suspension bridge, the stability of which depends almost entirely on the tensile resistance of the chains or cables. The greatest structure of this form is undoubtedly the George Washington Bridge over the Hudson River, New York, with its span of 3,400 ft.

In most iron and steel structures the resistance of the material to both tension and compression contributes to their stability in equal proportions, as is found in the great girder and cantilever bridges. Reinforced concrete, in which the great strength of concrete to resist compression is combined with the power of steel to resist tension, owes its development largely to the facility with which it can be built and shaped. Tunnels of masonry or brickwork, and cast-iron lined tube tunnels, subject to the pressure of great depths of earth, are forms of structure the stabilities of which are not easy to calculate.

* From the presidential address to Section G (Engineering) of the British Association delivered at Norwich on September 5.

There are two sides to all problems in stability; the first depends on applied mechanics, the second on the regulation of stresses to get an economical use of material. Progress in the second during the last fifty years has not been so great as in the first, to which my remarks refer more particularly. To fix the directions of, and arrange for the balance of, loads and forces, the conception of action along lines was introduced at an early stage. The position of such a line, with respect to the boundary of a member offering resistance, governs the distribution and intensity of stresses in the material. In estimating the intensity of stress, the position of the line in a lamina of the part under consideration is usually considered, and in it the distribution of the stress follows the 'trapezium law', which is a particular case of Galileo's solution of the beam problem. Thus if the line representing the centre of action of the load or thrust is on the centre of the section of the member, the stress intensity would be the same throughout the section. If the line of action is off the centre, then the intensity is increased on the side towards which the line has moved. The diagram representing the distribution of stress is a trapezium, the centre of gravity of which is on the line of action.

In a pier or buttress which supports and at the same time resists the thrust of an arch, the line representing the resultant of the weight and thrust of the arch is deflected downwards by the weight of the buttress, and the buttress may be so shaped that the deflected line is everywhere near the centre giving a uniform intensity of stress in the masonry, and uniform pressure on the ground below the foundations. On the other hand, the balance may not be so good, and the line may be towards the outer side of the buttress, giving high concentration in the masonry and ground.

Historically, the problem of the masonry arch is extremely interesting. The arch form of construction has been known for thousands of years, and several magnificent arches built by the Romans are still in a very good state. Real progress in the theory of the design and strength of the arch is comparatively recent.

In a masonry arch the line of thrust might occupy one of a variety of positions any of which would satisfy the requirements of equilibrium. For the purposes of design or estimating stability, some particular line must be chosen, and this can only be done by making assumptions, the validity

of which must have regard to the method of construction and the probable conditions of stress in the masonry. One assumption relates to the position of the line of thrust at the crown or springings. Since 1870, one of the advances made has been the introduction of definite hinges, at the crown or at the springing level, or at both places, to ensure the line of thrust passing through those points. These hinges render the problem of strength and stability much more definite, but with respect to arches without hinges the position is unchanged, although much has been done by comparing and analysing existing structures. In the monumental work by Séjourné[1], particulars are given of all arches of appreciable size throughout the world: details of construction are given, and the proportions are analysed and compared.

Up to the first half of the nineteenth century, knowledge of the strengths and characteristics of materials, and of the branch of engineering science now known as 'applied mechanics', was not sufficient to establish or disprove the accuracy of various theories relating to the design or stability of a masonry arch then in vogue or from time to time propounded; efforts to make progress in the problem depended almost as much on dialectics as on mechanical principles.

Throughout a long period in the eighteenth and nineteenth centuries, mathematicians and others applied themselves to finding the exact form of the line of thrust that would ensure equilibrium in a mass of masonry bridging a void. The upper boundary of the mass was a horizontal surface representing the road surface and the lower one the intrados of the arch, shaped to conform to the line sought.

The shape of this arch of equilibrium was compared in great detail with those of the ellipse, cycloid, parabola, catenery and semi-circle or segment of a circle. Different writers strongly advocated one or other of these curves as being the true curve for an arch. The elaboration with which this was done seems remarkable, for many must have known that to build an arch to conform to a particular curve with the exactitude suggested is practically impossible. When the centering on which an arch is built is removed and the arch supports itself, the compression of the mortar in the joints and of the voissoir stones allows the arch to drop an amount which is quite sufficient to alter the shape appreciably; thus the arches of Perronet's famous bridge at Neuilly dropped, on decentering, enough to alter the radius curvature at the crown from 150 ft. to 244 ft., and if intended to be elliptical, it might have conformed actually more closely to a cycloid.

For the longest spans, reinforced concrete has now superseded masonry; but fine masonry arches of 300-ft. span have been built. The construction of spans of increasing length has been made possible by improved technique in building. To avoid high stresses arising at the springing and key stone, as a result of the settlement or elastic deformation of the centering, as weight is added during building, and as a consequence of the initial deformation of the arch itself when the centering is removed, gaps are left in the arch, and special forms of construction are now introduced to act as temporary hinges, so that when the bridge is completed and the gaps filled in, the position of the line of thrust is fairly definitely known. In reinforced concrete arches, either permanent hinges of steel are introduced or else all the reinforcing bars are drawn together at the critical points to form a temporary hinge, and the surrounding concrete is filled in only on completion. Reinforced concrete arches with spans as great as 590 ft. have been constructed.

The stability of a masonry dam is a problem that has exercised the minds of engineers and mathematicians for many years. The failure of the Bouzey dam in France in 1895 gave prominence to the problem. The Bouzey dam was straight with a length of 1,720 ft., and the water held up had a maximum depth of about 40 ft. When the dam failed, the upper 30 or 35 ft. of its height for a length of 560 ft. was swept away, and the flood, passing down the valley, caused great havoc, and eighty-six people lost their lives.

Investigations after the disaster revealed many points of interest. In the original design, the maximum pressure on the masonry was the only factor considered in calculating its proportions. In the course of the investigations after the disaster it was shown that the resultant of the thrust combined with the weight of the masonry was so placed that a tensile stress of 1·3 tons per sq. ft. must have been imposed on the masonry. Laboratory tests proved that the maximum tensile strength of the masonry was only 60 per cent higher. In opposition to the theory that the parts that failed had overturned by virtue of this weakness, it was held by some that failure was by shearing; the shearing stress being calculated as 1·32 tons per sq. ft. by some, and as 3·2 tons per sq. ft. by others.

Rankine, in 1871, had recommended that no horizontal joint in a dam should be expected to withstand any tensile stress; in other words, there should be no uplifting tendency. After the Bouzey disaster it was considered advisable that at the upstream face there must always be a definite compressive stress, and the French Government introduced the regulation that on horizontal joints there should be a vertical compressive stress at the water face equal to not less than the water pressure at the

joint. Such compression in the masonry would tend to prevent access of water to any joint or crack.

The late Sir Benjamin Baker, in 1904–5, at the time when I was his chief assistant, was faced with the problem of raising the Assuan dam. (At present the dam is being raised a second time.) The investigations after the disaster in France had shaken confidence in the accepted method of gauging the stability of a dam, and in 1904 a memoir was published entitled "Some Disregarded Points in the Stability of Masonry Dams", by Prof. Karl Pearson and Mr. Atcherley. By mathematical investigation, the authors concluded that although a dam might satisfy the usual conditions regarding the stresses on horizontal planes, it might still be subjected to dangerous tensile stresses on vertical planes in the vicinity of the downstream toe. That conclusion seemed most unlikely to engineers interested in the subject, but however incredible it might seem, it demanded attention as coming from so eminent a mathematician. In arriving at their results, the authors of the memoir based their calculations on an assumed law governing the distribution of shearing stress across the base. The unsatisfactory state of affairs could only be cleared up by determining the distribution of sheer and other stresses.

Jointly with my friend the late William Gore, I made an attempt to do this, and we embarked on a series of elaborate experiments with india-rubber models.

Our investigations were described and discussed at the time at the Institution of Civil Engineers[1] and in *Engineering*[2], in which journal there was correspondence on the subject.

The models were made of slabs of rubber 1 in. thick with a smooth white surface, and shaped to represent the transverse section of a dam. The model was strained by weights carefully adjusted to represent the water pressure against the face and the weight of the masonry, on the assumption that the masonry had a specific gravity of 2·25. The model was divided into sections, and the 'masonry weights' were hung on transverse pins put through the rubber. Plates pulled by cords against the water face represented the water pressure. To ensure the exact relative positions of the loads, the model was so shaped that when fully strained it had the correct profile. A network of lines was ruled on the rubber, and large-sized photographs on plate-glass were taken under the strained and unstrained conditions. Corresponding lengths on the two negatives could be measured accurately, and from them the strains and stresses were calculated. The intensity of shear at various points was measured by comparing angles on the two plates. Our investigations enabled us to plot curves of stress-distribution on section lines at various heights. The curves were of quite definite shape. We found no evidence of the reputed tensile stress at the downstream toe. The shear stress diagram was practically a triangle with the maximum at the downstream edge, and the vertical stress distribution agreed substantially with the 'trapezium law'.

These experiments helped materially to clear up the situation and to re-establish confidence in the method that had been in general use for estimating the stability of masonry dams.

During the last few years, investigations of problems relating to the design of large concrete dams and curved dams have been made in the United States. The influence of heat, both natural and that generated by the setting of cement, on stresses and stability, has received much attention. In these gigantic structures, monolithic construction and the use of too large masses of concrete has been found accountable for serious cracking.

The suspension-bridge or 'philosopher's bridge', as it has been called, is a fascinating type of structure. In the course of the development of its design and stability there have been some astonishing occurrences. In its most elementary form, the suspension-bridge formed of strong flexible climbing stems or roots has been used by primitive peoples for centuries. Examples made of wrought iron appear to have been in existence in the eighteenth century. At the beginning of the nineteenth century the chains, which were made up with several links side by side, connected with common hinge pins, were of uniform strength throughout their length, and the road or platform was suspended by vertical rods. Within its limitations, this was a satisfactory form of construction. In a bridge which carries a series of loads on a flexible chain, the loads and the chains are only in equilibrium when the chain assumes an appropriate shape, and to support any additional weight or rearrangement of weights the chain changes its shape slightly. With a moving load; the tendency of the platform of a suspension-bridge to undulate with the passage of the load has handicapped the development of this type of bridge. An early attempt to use it for a railway proved a complete failure.

Telford's famous bridge across the Menai Straits, with a span of 570 ft., completed in 1826, is of the simple suspension type. At first the platform was too flexible and caused anxiety, but that part was altered and made stiffer. The bridge is still in service, and is standing proof that in principle and construction it was sound. A few years later, a supposed improvement, the 'taper chain' bridge, was introduced with the object of reducing the amount of iron required. The principle was unsound, and failures led to the suspension type of

bridge being regarded with suspicion for many years.

Several suspension-bridges, built before 1836, are still in use. In all these the chains are of uniform strength throughout, and the whole weight of the bridge is suspended from them.

The flexibility of these bridges under heavy moving loads is a source of trouble, and of wear and tear of the platforms. Nevertheless, when the chains are pulled by the loads into a line of equilibrium, so long as the anchorages are secure and the towers are sound, the stability depends solely on the tensile strength of the chain, and under these conditions almost all suspension-bridges have a substantial margin of strength or stability.

One of the early suspension-bridges still in use is that across the Thames at Marlow, built by W. Tierney Clark, in 1829. I examined and reported on this bridge some years ago and found it in a remarkably good state. In the development of the stability of suspension-bridges this one is of particular interest, for it was the first built with stiffening girders. The ends of the cross girders in this bridge are all stiffly connected by parapets made in the form of girders, and any cross girders on which a heavy load might rest cannot deflect the suspension chain, as it would do if the parapet girders were not there.

In the modern suspension-bridge the stiffening girder is as important a feature as the chain or cable, and its introduction has made it possible to construct the gigantic bridges in the United States. The interaction of the stiffness or flexibility of the girder with the curvature of the suspension cable is the governing factor in the stability of the modern suspension-bridge.

The latest example of suspension-bridge with its span of 3,400 ft. and others of more than 1,500 ft. compare with Telford's of 570 ft. and the others of 50–200 ft. Cables composed of thousands of steel wires, four times as strong as iron, laid side by side to form cables 3 ft. in diameter, take the place of the iron chains; and the flexible timber platform, so easily deformed by moderate moving loads, is now replaced by deep steel stiffening girders with upper and lower decks providing double tracks for both electric railways and street trams and road width for many cars.

[1] Paul Séjourné, "Grandes Voutes", 1913–1916.
[2] *Minutes of Proceedings Inst. C.E.*, 172; 1907–8.
[3] *Engineering*, 1905, 1907. Also NATURE, Jan. 30, 1908.

International Physiological Congress

MEETING IN THE U.S.S.R.

THE fifteenth International Physiological Congress met, under the presidential direction of Prof. I. P. Pavlov, in Leningrad and Moscow on August 8–18. The gathering proved of unusual interest, especially from the social point of view. The members, numbering more than eight hundred foreigners and about five hundred Russians, were given an opportunity to see something of the mechanism of the communistic regime. The several receptions and banquets in the old royal palaces gave the members a glimpse of the almost oriental splendour which surrounded the ruling class under the Czars.

The Russian National Committee and the Soviet Government treated the Congress with unique hospitality. From the initial, informal reception in the magnificent Marble Hall of the Ethnographical Museum in Leningrad, to the final banquet in the Grand Palace of the Kremlin, and the aviation display on the outskirts of Moscow, the entertainments arranged for the Congress were consistently lavish.

The three plenary sessions, at which five scientific papers were read by well-known physiologists, were the outstanding occasions of the Congress. The first plenary session was opened by Prof. Pavlov, who gave the Congress a stirring welcome. The paper delivered at this time by Prof. Walter B. Cannon (Boston) was entitled "Some Implications of the Evidence for Chemical Transmission of Nerve Impulses". It constituted an outline of present knowledge in the field of neurohumours. Both the sympathetic nervous system and its chemical representative, adrenalin, act in a widespread manner. Acetylcholine is the chemical representative of the parasympathetic nervous system. Unlike adrenalin, acetylcholine is very unstable. Thus its action is limited to the region in which it is produced. The action of the parasympathetic nervous system is similarly localised.

The evidence for the existence of two adrenalin-like or adrenergic neurohumours was cited. These were named sympathin E (excitatory) and sympathin I (inhibitory). Langley suggested this concept in 1905. He further believed that the differentiation probably takes place in the effector cells, and this is to-day unrefuted but unproved. Possibly the sympathetic mediator, acetylcholine, has excitatory and inhibitory forms. At present,

however, this substance has never been obtained in a specific form. The action is always either excitatory or inhibitory, depending on the function of the parasympathetic nervous system in the organ involved.

The evidence for the chemical mediation of autonomic nerve impulses at the periphery is convincing in the cases of non-striated and cardiac muscle, digestive and sweat glands. There is certainly suggestive evidence for a chemical mediator, acetylcholine, of motor nerve impulses to striated muscle. The recent work on non-striated and cardiac muscle, showing spatial and temporal summation of nerve impulses, gives strong support for the theory of the quantal production of chemical mediator by each nerve impulse.

The evidence for chemical mediation between neurones is quite convincing in the case of sympathetic ganglia. Synaptic transmission in the central nervous system may be by neurohumours although the evidence for this is meagre as yet. Prof. Cannon ended by commenting on the fact that progress in this field is so rapid that his treatment of the subject was probably not strictly up-to-date.

The secondary plenary session opened with a paper by Prof. L. A. Orbeli (Leningrad) on "Pain and its Physiological Effects". A detailed account of the work of the British neurologist, Henry Head, on the problems of pain was given. Much of Head's work, performed in 1905, has been repeated and verified quite recently in the Soviet laboratories. Orbeli believes that he has shown that sympathetic nerve distribution is regional. Thus one nerve cell branches to give fibres to skin, muscles and internal organs of a given cross-section of the body. He believes that 'referred pain' operates through this sympathetic mechanism.

When a visceral organ is diseased, sympathetic impulses are set up which, travelling to the skin, alter the degree of excitability of the sensory endings there, giving hyperæsthesia or pain.

Sir Joseph Barcroft (Cambridge) presented, also at the second plenary session, a paper on "The Velocities of some Physiological Processes". Dealing chiefly with respiratory mechanisms, he pointed out the necessity of comparing the velocities of the chemical and the physical processes involved. In the ordinary loading and unloading of oxygen the chemical events take place so much more rapidly than the physical that only the rates of the latter need be considered. However, the chemical velocities assume special importance in some cases. Hæmoglobin takes several hundred times as long to part with carbon monoxide as with oxygen. This fact is of prime importance in the study of carbon monoxide poisoning.

Chemical velocities in respiration become specially important in muscles which act rhythmically over long periods of time. In these places oxygen transport from capillaries to tissue cells is accomplished by muscle hæmoglobin (myoglobin), and in some species by cytochrome. Myoglobin is six times as fast as hæmoglobin in its reactions with oxygen. Cytochrome is even faster. This velocity assumes real importance in certain cases, as in the hearts of small mammals and birds, where the heart rate may approach one thousand beats a minute.

The velocities of intracellular oxidations and the catalysts involved were discussed at some length. One molecule of oxygenase, probably the chief intracellular oxidative enzyme, can deal with one hundred thousand molecules of oxygen per second at 10° C. If the molecules are dealt with one after another, the interval between molecules will not be more than ten millionths of a second. Assuming an adequate concentration of the enzyme, this velocity would not constitute a limiting factor for even the fastest physiological process.

The velocity of the chemical process involved in the dissipation of carbon dioxide in the lungs is very slow. Between the breaking up of sodium bicarbonate in the body and the evolution of carbon dioxide there is the slow formation of carbon dioxide and water from unionised carbonic acid. Recently it has been shown that the latter process is speeded up by an enzyme, carbonic anhydrase, which is found in the red blood corpuscles. The bicarbonate obtains access to the enzyme through exchange with the chloride ions inside the corpuscles.

Sir Joseph Barcroft ended by pointing out an interesting discovery resulting from the study of chemical velocities. Consideration of the rate of evolution of carbon dioxide has led the Cambridge group of workers to the conclusion that 2–10 per cent of the carbon dioxide in the blood is present, not as bicarbonate, but in the more active carbamino form.

Prof. L. Lapicque (Paris) delivered the first paper of the third plenary session, held in Moscow, on "Some Recent Advances in the Knowledge of the Nervous Mechanism". The well-known concepts of chronaxie, isochronism and heterochronism were treated. New experimental material was brought forward in support of the speaker's disputed views on these subjects. Lapicque and his colleagues have found that muscles which work together have the same chronaxie; antagonistic groups have different chronaxies. He also finds changes in the chronaxie of peripheral nerves following central nervous activity. Indeed, when a conditioned reflex is elicited it is claimed that the peripheral portions of the pathway undergo a change in chronaxie due to the central activity.

The final paper of the third plenary session was given by Prof. A. A. Ukhtomsky (Leningrad) on "Physiological Lability and the Act of Inhibition". An account was given of the research work conducted in the Russian laboratories in an attempt to show the relation between chronaxie and what they term "functional lability". This "functional lability" is defined as the factor limiting the conduction of impulses in any excitable tissue. It determines whether a tissue is excited or inhibited by a stimulating agent. Both processes, they intimate, are active, and both must be initiated by stimulation.

The general meetings were divided into thirty sections according to subject, five sections usually operating at one time. At these meetings, 485 papers were presented. In the appended table the papers are grouped under twelve subject headings. This table gives some indication of the interests of physiologists in the countries represented at the Congress. The body of material presented was so large and varied, and the time so short, that many members found it difficult to glean much of value from these meetings. An attempt will probably be made, at the next Congress, to rectify this weakness in the programme arrangements.

CLASSIFICATION OF PAPERS PRESENTED TO "THE 15TH INTERNATIONAL PHYSIOLOGICAL CONGRESS"

SUBJECT	NUMBER OF PAPERS PRESENTED From U.S.S.R.	From other Countries
Applied Physiology (Industrial)	8	4
Biochemistry	20	69
Circulation and Heart	4	19
Excretion	2	9
General and Cellular Physiology	24	51
Internal Secretion	8	25
Metabolism, Nutrition and Vitamins	4	28
Nervous System and Nerve-Muscle Physiology	65	59
Pharmacology	15	19
Physical Factors in Biology	5	8
Sense Organs	11	13
Sexual Cycle	4	11
TOTALS	170	315
TOTAL NUMBER OF PAPERS	485	

The U.S.S.R. research centres provided a notable group of permanent demonstrations. In part, these served to show the type of experimental work in progress. The Soviet physiologists are chiefly occupied in researches on the nervous system with special reference to conditioned reflexes, researches in the industrial aspects of work, and researches into the special physiology of the woman and the child. The table summarising the types of papers presented at the general meetings gives further indication of the trend of physiological investigation in the U.S.S.R.

To a large extent, the aim of the permanent demonstrations was to show the expansion of scientific laboratories and personnel under the Soviet regime. This aspect was further stressed when the delegates were taken to visit the various laboratories. The expansion has been amazing. In the days before the revolution there were 24 institutions carrying on physiological research. To-day there are said to be 380 such institutions. The increase in personnel has been correspondingly great. Scientific people cannot but applaud the attitude of a State which so generously supports scientific endeavour. One wonders, however, if such expansion can be altogether sound. The All-Union Institute of Experimental Medicine (VIEM) had a staff of 393 in 1931 which has been increased to 2,200 for 1935; the increase in monetary grant has been commensurate. Expansion of this nature is to be found on all sides in the biological and medical sciences. It is a rate of expansion which would hopelessly overtax the highly developed educational facilities of either Great Britain or the United States of America. Just how well the less extensive Soviet educational system equips its scientific workers is a matter for conjecture. It is certain that the body of Soviet scientists know too little about what is going on outside the U.S.S.R. Practically none of them has studied abroad. Foreign scientific journals are scarce. Although the U.S.A. and the U.S.S.R. are comparable countries from the point of view of numbers of workers in biochemistry and physiology, the *Biochemical Journal* has 346 subscribers in the U.S.A. and only 46 in the U.S.S.R., the *Journal of Physiology* has 211 subscribers in the U.S.A. and only 26 in the U.S.S.R. The scarcity of periodicals in foreign languages other than English is apparently even more serious.

There is certainly no lack of interest in the work and opinions of foreign scientists. A well-known English monograph on a physiological subject was recently translated into Russian and printed by the Soviet authorities. Three thousand copies were sold in about a month, a remarkable sale for a scientific monograph in any language. The young Soviet scientist is enthusiastic and eager for knowledge. It is to be hoped that the international attitude shown by the Soviet Government in its treatment of, and its speeches to, the Congress will be extended to the training of its own scientists.

One of the most important features of the Congress was the report of the Permanent International Committee, delivered to the third plenary session in Moscow by its secretary, Prof. A. V. Hill. The Committee regretted the retirement of W. H. Howell (Baltimore) and J. E. Johansson (Stockholm). W. B. Cannon (Boston) and G. Liljestrand (Stockholm) were elected in their places. The other members are F. Bottazzi (Naples), O. Frank (Munich), A. V. Hill (London), L. Lapicque (Paris) and I. P. Pavlov (Leningrad).

The 1938 Congress was invited, by Prof. Hess and the Society of Swiss Physiologists, to meet in Zurich. This invitation, on the recommendation

of the Committee, was accepted by the Congress. Since 1938 is the Jubilee of the suggestion of the Physiological Society that an International Congress should be founded, and since the first Congress was held in Switzerland in 1889, the choice of Zurich is particularly suitable. The Committee, however, was sympathetic to the wish of the Hungarian Physiological Society that the Congress should meet some time in Hungary, possibly in 1941.

The International Committee suggested to the Swiss National Committee that applications for membership in the Congress be not accepted, except in special circumstances, from individuals, but only through national physiological organisations. It further advised the National Committee that, for the sake of economy, the programme, particularly in respect of entertainments, should be simplified.

The International Committee had the support of the Congress in recommending certain changes in programme arrangements. It advised that any registered member be entitled to submit a communication for printing, and that such communications should be circulated to all members some time before the Congress. Any member desiring to discuss any communication should then inform the officers of the Congress. The papers thus chosen for their general interest should be grouped, so that each meeting may form a co-ordinated discussion on a certain subject. There should be no actual presentation of individual papers.

At this third plenary session, the closing scientific meeting of the Congress, the International Committee expressed itself as deeply grateful to their Soviet colleagues for the welcome they had extended to the Congress. Prof. G. Barger (Edinburgh), speaking in eight languages, on behalf of members of the Congress, admirably expressed the general appreciation. D. Y. SOLANDT.

The Species Problem

KING CHARLES'S head was a less recrudescent topic than the species problem, which was recently the theme of the presidential address to the Zoological Section of the British Association, and the text of a symposium occupying most of a morning session. The reason for the perennial airing of the problem is not far to seek; for it is fundamental to all biological science. Taxonomy, begun in the good old days when species *were* species, has to adapt itself to the sliding scale of evolution; and phylogeny and genetics have to attempt to account for the phenomena that once made the Linnean system appear reasonable. Zoology has been driven by the concept of evolution into its proper role of a science that transcends mere description; while palæontology has developed beyond its erstwhile function as a handmaid of geology into an essential part of biological science.

In this inquiry, zoology, labouring under the disadvantage of its ephemeral scope, is concerned mainly with the causes of variation; while palæontology records the effects, as best it may, from fragmentary evidence in which causative processes are matters of inference or speculation. The two sciences have a common aim, but widely contrasted outlook and methods. In the past, they have too often followed their own devices, the zoologist looking askance at the imperfection of fossil evidence and the palæontologist deriding phylogenetic speculations hopelessly at variance with his small, but definite, knowledge.

The problem is summarised in the question: What is a species? All biologists are agreed that a species is an abstract conception; for in real life there is no fixity. If a species is to be adequately defined, the definition must include an account of its birth and breeding as well as of its present state. Hence the answer to the question can be found only in the solution of the wider mystery of the 'origin of species'.

Variability is an essential attribute of organisms, and sexual reproduction merely develops permutations and combinations of differences already present in the parents. If this be granted, the problem is reduced (but scarcely simplified) into that of the causes of variation. Here evidently is a question for the geneticist; although it is doubtful if his experiments, carried out under some measure of artificial control, can give a true picture of natural causes. Zoologists and palæontologists can record the cumulative effects of untrammelled variation, and the truth can perhaps be approached most nearly by deduction from their observations.

Variation may be traced in space and time. The occurrence of local races in geographically separate areas is analogous with the succession of changes which give to fossils their value as zonal indices. But whereas the area of any one type of environment is necessarily much less than the already limited area of the surface of the globe, the time during which such an environment may persist, in one part of the world or another,

is almost inconceivably great. It is possible to argue that a species whose variability can produce nothing more than local races during the period of its dispersion will, in the course of geological time, give rise to differences of specific or even greater significance. Such an argument, while bringing us no nearer to the root of the problem, serves to emphasise the importance of the time-element.

Many, but not all, of the differences shown by local races can be correlated with the conditions of their habitat, so that the direct influence of environment on the trend of variation becomes conceivable. Almost the same generalisation can be applied to palæontological 'lineages', with the same reservation. In both cases, any influence due to environment must be slight, and within the capacity of the organism; the alternative is extinction.

In this connexion, it is salutary to remember that almost every conceivable kind of environment exists somewhere on the globe; and, for many types of organisms, is not wholly inaccessible. When viewed in geological perspective, this condition is just as true, and its implications seem clear. An episode in the history of the sea-urchins may be cited in illustration.

So far as can be determined, the earliest sea-urchins lived quietly on the silt of sheltered lagoons; throughout the Palæozoic era they remained for the most part content with this kind of environment. But near the beginning of Mesozoic time a strange 'wanderlust' seems to have overcome some of these sea-urchins, evoking rock-dwelling types of which *Echinus* is a familiar representative. There must have been wave-swept rocks around Palæozoic seas; and there are plenty of areas of sheltered water to-day. *Cidaris* (by conservatism) and the heart-urchins (by reversion) still frequent the traditional quiet places; but *Echinus* and its relatives prefer the buffeting of the surge. The adaptation of each type to its habitat is almost teleologically perfect. But which came first, the habitat or the structures to fit it? Herein lies the dilemma. We must envisage either a gradual migration of successive generations of selected Triassic sea-urchins, travelling further into rough water as their variations permitted; or an almost infinitely slow invasion of some lagoons by the breakers. Both explanations seem to the last degree improbable.

An impasse of this kind can only mean that an essential factor has been left out of the calculation. In his laudable endeavour to avoid crediting lower types of organisms with attributes that belong to himself, the biologist has perhaps gone too far, and has treated his subjects as if they were as passive as inorganic matter.

To be alive is to be in active revolt against the cruder physical laws. Without the instinctive urge that is expressed among mankind in pioneering exploits, all protoplasm might still be content to remain amœboid.

This contention does not in any way solve the mystery of variation; but it widens the scope of the inquiry. For living beings, the attributes of variability and 'choice' must be stronger influences than the impact of inanimate environment. Every organism must triumph over its environment, find a new one, or perish in the attempt.

HERBERT L. HAWKINS.

Obituary

Mr. E. Thurston, C.I.E.

WE regret to record the death of Mr. Edgar Thurston, formerly superintendent of the Government Museum, Madras, which took place at Penzance on October 5 at the age of eighty years.

Edgar Thurston, the second son of Charles Bosworth Thurston, was born at Kew and educated at Eton and the medical school of King's College, London, qualifying as L.R.C.P. in 1877. He was appointed superintendent of the Government Museum, Madras, in 1885, retaining that position until his retirement just under twenty-five years later, when he was made C.I.E. He had already received the award of the Kaisar-i-Hind gold medal in 1902. After his retirement he returned to England, and continued to devote himself to research. He was much interested in the study of the Cornish flora, publishing "British and Foreign Trees and Shrubs in Cornwall" in 1930.

As superintendent of the Madras Museum, Thurston took an active interest in all the branches of scientific study in the Presidency which came within the purview of his duties; but as was shown by his numerous contributions to the official publication of the Museum, his main preoccupation lay with anthropology. Here he took the broadest view of the functions of the museum man, and by no means confined his attention to material culture and its contributory research. He acquired a knowledge of the mentality of the varied peoples of the Presidency and a keen appreciation of their differences, which at times was little short of surprising. The results of his earlier studies were embodied in "Ethnographic Studies in Southern India"; but his

wide and detailed knowledge of social institutions, customs and beliefs, enriched by the information collected in an ethnographical survey, which he conducted in 1902–9, appeared to advantage in his "Castes and Tribes of Southern India" (1909), in which he added to his own observations a digest of a vast amount of other material. No less remarkable in the character of its observations and its originality was "Omens and Superstitions of Southern India", a book which has proved of the greatest interest and value to students of folklore and religion.

Thurston was ever generous in placing his material at the disposal of others. Not only were his researches of the greatest utility to Sir Herbert Risley in his ethnographic survey work in India, but also it was largely owing to Thurston's assistance, which extended from the organisation of transport to counsel and information in matters of ethnographic detail, that the late Dr. W. H. R. Rivers owed, as he himself acknowledged, the remarkable achievement of his anthropological investigations among the Todas of the Nilgiri Hills. Thurston's retirement was a loss to anthropological studies in the Madras Presidency, of which the effect is still apparent. No one has quite taken his place.

WE regret to announce the following deaths:

Prof. G. Buchböck, professor of chemistry in the University of Budapest, aged sixty-six years.

Dr. H. W. Dudley, O.B.E., F.R.S., of the National Institute for Medical Research, known for his work in biochemistry, on October 3, aged forty-seven years.

Prof. Rhoda Erdmann, director of the Institute for Experimental Cytology in the University of Berlin, and editor of the *Archiv für Experimentelle Zellforschung*, on August 23, aged sixty-four years.

Mr. G. H. Hamilton, official astronomer in the Jamaica branch of the Harvard Observatory in 1922–24, and since 1924 astronomer of the Hamilton Observatory, Mandeville, Jamaica, on August 6, aged fifty-one years.

Mr. W. K. Laurie-Dickson, who was associated with Mr. Edison in studies of the Edison effect, and for many years superintendent of the Edison Electrical Works, on September 28, aged seventy-five years.

Major R. F. Stirling, director of veterinary services, Central Provinces, India, known for his work on animal diseases, especially rinderpest, on August 16, aged forty-eight years.

News and Views

Safeguarding of Peace

"COLLECTIVE Security" is a problem which to-day is thrust upon the notice of every newspaper reader. Few of them are aware that to the scientific investigation of this same problem in international relations two whole years have just been devoted by a score of national groups and institutions affiliated to the Permanent International Studies Conference. At the London session of the Conference, held last June, the investigations culminated in a discussion directed more particularly to four essential aspects of the subject: the notion of collective security, the prevention of war, determination of the aggressor and sanctions, and the question of neutrality. The major portion of the deliberations was devoted to the principle of the organisation of pacific systems destined to eliminate the causes of war to the fullest possible extent. In connexion with the repression of war, the discussion turned on regional agreements and the relative value of various forms of sanctions, notably economic and military. There followed an examination of the notion of neutrality and the different forms it may assume when the collective machinery set up for the safeguarding of peace has to be put into operation. The subject chosen for the next Study Conference to be held in 1937 is 'Peaceful Change', with special reference to questions of (*a*) population, migration and colonisation, and (*b*) markets and the distribution of raw materials. The proceedings of the London session are summarised in Appendix 6 to the Report of the International Committee on Intellectual Co-operation (League of Nations Publications, 1935, **12**, *A*2. Allen and Unwin, 2*s*. 6*d*). The same report outlines definite proposals submitted by M. Jean Gérard, secretary-general of the International Union of Pure and Applied Chemistry, for establishing closer collaboration between the International Committee on Intellectual Co-operation and the International Council of Scientific Unions. The proposals are to be laid before a special committee of this Council, appointed to deal with the subject.

New Commission of the R.R.S. *Discovery II*

THE Royal Research Ship *Discovery II* left London on October 3 on her fourth Antarctic commission. The voyage is expected to last for some twenty months, and, as on former occasions, the work is primarily concerned with observations on the distribution and environment of the whales which form the basis of the southern whaling industry. According to the programme which has been arranged, the ship, after calling at Cape Town, will circumnavigate the Antarctic continent, returning to South Africa in June 1936. The distribution of whales near the ice edge will be examined in each sector of the Antarctic, and series of stations with full observations on the hydrology and plankton will be taken on lines extending from the pack ice to the warmer waters north of the Antarctic convergence. This circumnavigation is being made in the summer months, and will be complementary to that undertaken in the winter of 1932. The work is controlled by the *Discovery* Committee

acting under the instructions of the Secretary of State for the Colonies. The present voyage is under the leadership of Mr. G. E. R. Deacon, with Lieut. L. C. Hill, R.N.R., in executive command. The other members of the scientific staff are Mr. J. W. S. Marr and Dr. F. D. Ommanney, with Mr. A. Saunders as laboratory assistant and photographer.

Racial Studies

A NEW publication devoted to racial studies may count with certainty on an interested audience at the present moment, when racial questions have come to have an outstanding importance in international and national affairs. Racial characters have ceased to be regarded as of purely academic interest; but since they have been made the pivotal factor in nationalist propaganda, the public, bewildered by conflicting statements as to the meaning and province of 'race' in the modern world, welcomes an impartial and scientific examination of both general and specific problems. The *Zeitschrift für Rassenkund und ihre Nachbargebiete*, which has completed its first volume by the issue of a third part in May last, has been founded for the purpose of examining problems of race on scientific lines, dealing not only with broader issues, but also investigating racial problems as they arise in defined areas and specific groups. The treatment of the subject is not confined to discussion of physical characters alone, but will take into account the evidence of psychology and social anthropology, prehistory and linguistics. It is proposed thus to cover the whole field of the racial problems which arise in the study of the development of man in time and space. The editor is Egon, Freiherr von Eickstedt, director of the Anthropological and Ethnological Institute of Breslau; and he has secured a promise of co-operation and collaboration from a large and representative body of anthropologists from all over the world. Two volumes of three parts each will be published annually at a subscription price of 22 gold marks for each volume. The first part of the second volume appeared in July.

Food of Peking Man

AN interesting light is thrown on the mode of life of Peking man in a communication by Dr. Ralph W. Chaney, of the Department of Palæontology, University of California, and research associate of the Carnegie Institution of Washington, D.C., which is issued in the *News Service Bulletin* of the Institution. It would appear that Peking man supplemented the meat diet provided by the game animals of the hills and plains by vegetable food, which he obtained as a 'food-gatherer'. About twenty feet above the lowest level of human occupation in the Chou-kou-tien cave and in a breccia containing numerous quartz artefacts and bone fragments, there is a layer several inches thick, made up of thousands of fragments of the shells of seeds. The markings on the shells indicate that they are hackberry seeds, globular bodies smaller than peas. The modern hackberry (*Celtis*) occurs as a small tree in the forests both of North America and Asia, but is most characteristic as a shrub on semi-arid slopes and stream borders. As it is improbable that they could have been introduced into the cave by any other agency than animals or man, it may safely be assumed that they formed part of the food of one or the other, their shells having been crushed while being eaten. In the United States the berries are extensively used as food by birds, rodents and the Indians, especially in the south-west. The most common use is as a flavouring for meat or bread. In order to eliminate the possibility of these seeds having been introduced into the cave by rodents, experimental observations have been made in which it was found that monkeys alone broke up the shells in a manner corresponding to that in which the shells in the cave had been broken. It is, therefore, more than probable that the seeds were brought to the cave by human agency and that the hackberry seeds afford the earliest known example of a vegetable food used by primitive man.

New Flying Boats for British Empire Air Lines

IT is announced that Imperial Airways have placed an order with Messrs. Short Bros., Ltd., of Rochester, for a fleet of flying boats specified to be both larger and faster than any of a similar class now in existence. The order provides several innovations, the most startling of which is that the type of engine will not be decided until absolutely necessary for the completion of the design. It will thus be possible to take advantage of accumulating experience in the use of several different types, some of which are as yet not very thoroughly tried out under such conditions. It is also understood that the number of machines to be ordered is not yet settled, but will depend upon their suitability for the varying conditions in the different Empire routes. The new boats are to be high-wing monoplanes, without external bracing, and carrying wing tip floats. These will be the first marine aircraft in Imperial Airways fleet to depart from the more usual biplane construction. The size of the hull is such that the forepart can be given two decks, the upper one for the crew, ship's offices, and cargo, and the lower one for passengers. Their total loaded weight will be 17½ tons, about 30 per cent increase upon the present largest boat in Imperial Airways service, of which 3½–5 tons is available for paying load, depending upon the length of the flight between refuellings. The estimated speed is nearly 200 miles per hour, with a range of up to 1,500 miles. This allows them to undertake the two longest stages on the all-Empire route (except the Atlantic), that is, between England and Gibraltar, and Australia and New Zealand.

History of Medicine Congress at Madrid

AT the International Congress of the History of Medicine, held at Madrid on September 23–29, under the patronage of the President of the Spanish Republic, there was an exhibition of medical manuscripts, documents, instruments, etc. The Wellcome Historical Medical Museum contributed some interesting

illustrations and objects to this exhibition. Among these were illustrations of Arabian surgical instruments from early fourteenth century manuscripts ; examples of the medical and other works of Maimonides, the Hispano-Jewish philosopher and physician of the twelfth century ; replicas of the earliest MSS. of the life of Andres Laguna, physician to Charles V and Pope Julian III ; Roman, medieval, Hindu and modern surgical instruments ; historical objects such as Egyptian artificial eyes, anatomical models, and a special section devoted to the evolution of spectacles. Part of the Museum's exhibit comprised interesting dioramas including Nicholas Monardes of Seville (1512–88) depicted working in his private museum of curiosities ; a historic incident connected with the discovery of cinchona bark as a remedy for malaria (1630) ; a thirteenth century apothecary's shop in Cordova (Fig. 1) ; and an interior view of the hospital of Santa Cruz at Toledo as it appeared in the sixteenth century.

FIG. 1. Diorama of a Hispano-Moresque apothecary's shop.
Copyright: The Wellcome Historical Medical Museum (The Wellcome Foundation, Ltd.).

Scientific Control of Road Traffic

ON September 10, at the British Association meeting in Norwich, Mr. A. T. V. Robinson opened a joint discussion in Sections G (Engineering) and J (Psychology) on the control of road traffic. He said that the question is far wider than merely the prevention of accidents ; that it is how to move with a minimum of delay, discomfort and damage a system consisting of heterogeneous units of passengers and goods travelling for industry and pleasure in all directions. Of the year's total of 7,000 fatal accidents, about 2 per cent were due to the defects of the vehicle, somewhat less than 2 per cent to defects of the road, and the remaining 96 per cent were due to the personal equation. Engineers study either the roads or the vehicles, and the psychologist studies the drivers and pedestrians. Mr. Robinson emphasised the importance of the colourisation of the 'carpeting' of the road, and said we ought to endeavour to get road carpeting of a lighter hue. In the future it is possible that on all the busy roads lights on the vehicles may be unnecessary and the approaching driver will see the oncoming vehicle, not as a couple of spots of dazzling light on a black background, but as a dark silhouette against an adequately illuminated road. The improvements in vehicles, especially the introduction of four-wheeled brakes, has greatly facilitated free movement of traffic on the streets, and the compulsory test for every new driver has worked admirably, about 12 per cent being rejected. It is recognised that certain drivers are 'accident prone'. and these must be eliminated as soon as possible. Science may help us to keep the demonstrably unfit off the road, but until science, and not a human driver, assumes control of the vehicle, occasional breakdowns in traffic control are bound to occur.

Fewer Accidents in Well-Lighted Streets

ACCORDING to the *Electrician* of September 20 the first accident statistics for the section of the highway between Versailles and Ville d'Avray have been published. This road has recently been lighted with sodium vapour lamps (discharge tube lamps), and the statistics show a reduction of 74 per cent in the number of accidents, none of which was of a serious nature. Local authorities should consider these figures, which prove that lives can be saved by the proper lighting of rural roads.

Closing Down of Private Electric Generating Stations

SEVERAL of the large factories in Great Britain have been considering whether it is an economical proposition to close down their generating stations and take their electric supply from the Grid. As the facilities offered by the public supply increase and the price diminishes, the advantages in its favour are rapidly increasing. Messrs. Lever Bros., of Port Sunlight, who were well known to have one of the largest and most efficient private plants in the country, have now entered into an arrangement whereby their power station becomes associated with the Grid, and will, under the direction of the Central Board, be operated by the Birkenhead Station. The load taken will be 40 million units a year, which is equivalent to the needs of a large town. The consumption of Birkenhead itself is 41 million units and the consumption of towns such as Oxford, Peterborough and Plymouth are less than 40 million units. Port Sunlight, the centre of the great soap and similar products manufacturing business, has an area of about 2,000 acres, and several other firms have established factories on the estate. The demand is likely to increase in the future. Among other large firms which have recently changed over from a private to

a public supply are the steelworks of Stewarts and Lloyds at Corby, those of Firth Brown at Sheffield and the thread mills of J. and P. Coats at Paisley.

High-Definition Television Transmission

IN connexion with the high-definition television transmissions which will be radiated from the Alexandra Palace, the British Broadcasting Corporation has requested Baird Television, Ltd., and Marconi-E.M.I. Television Co., Ltd., to send to manufacturers a complete specification of the waveform which they will radiate in their television transmissions from the palace. We have received from each of the companies their specifications, which are highly technical and will be mainly of interest to manufacturers. The ratio of the horizontal to the vertical breadth of the pictures is four to three for the Baird transmissions and five to four for the E.M.I. transmissions. The latter system transmits 25 complete pictures per second each of 405 total lines. These lines are 'interlaced' so that the frame and flicker frequency is 50 per second. It is claimed that good pictures can be received, although only a fraction of the radiated band is used; but the greater the width of the transmitted band utilised the better the received picture.

High Pressure Turbine Practice

IMPORTANT developments are taking place in the large power stations of electric supply companies. In the *Electrical Times* of September 19 there is an interesting account of the Loëffler boilers, which will supply steam turbines at the enormous pressure of 2,000 pounds per square inch. The exhaust steam from the high-pressure turbine is at a pressure of about 195 pounds per sq. in. and is reheated by steam from the boilers before passing into the low-pressure turbine. The North Metropolitan Supply Co. has two stations at Brimsdown called *A* and *B*. In the old station *A* the conditions were unfavourable to economical generation as the turbine pressure was only 150 lb. per sq. in. Owing to the favourable economic possibilities offered by the Loëffler boiler the station is being altered; two boilers each having a capacity of 210,000 lb. per hour, each operating at a pressure of 2,000 lb. per sq. in. and at a total temperature of 940° F., have been ordered from the Mitchell Engineering Co., Ltd., which has acquired the British rights from the well-known firm of Vitcovice. If petrol drops on the steam pipes at these high temperatures it bursts into flame. About twenty of these boilers are used abroad in Czechoslovakia, Germany and Russia. To get the best results it was necessary to have a set of 50,000 kilowatts. As a machine of this size could not be fitted into Brimsdown *A* it was divided into two. The high-pressure part has a power of 20,000 kw. and the low-pressure part has a power of 30,000 kw. It is claimed that certain advantages will accrue from running the machines in series.

The Lower Yield Point of Stress

THE report of the British Association (Section G), Committee on Stresses in Overstrained Materials, presented at Norwich, states that particular consideration has been given to the requirements of the engineering profession and industry in view of present and future developments. By the increasing use of electric and other methods of welding in structural work, the problem of plastic overstrain has reached such high importance as to become one of the determining factors in design, and the Committee puts forward the considered view that the so-called 'lower yield point' affords the most satisfactory and reliable basis for the comparison of structural steels. The several advantages attached to its adoption are set forth seriatim, and a draft specification is submitted. The Committee, of which the chairman is Sir Henry Fowler, expresses the opinion that the lower yield point should be included in the British Standard Specifications, and recommends that the desirability of its addition be brought to the notice of the British Standards Institution.

Publication of Scientific Literature

THE projects for scientific publication and bibliography (cf. NATURE, **133**, 641; 1934) have been implemented by a grant of 15,000 dollars from Chemical Foundation. As a result, a new Documentation Division of Science Service has been initiated in furtherance of activities in this field which were considered at a conference called by Science Service on July 11 and July 29. The immediate objectives being attempted under the grant are the development of camera, projection pointer, reading machine for microphotographs and other means for photographic reproduction, and the establishment of a project for the photographic publication of papers which at present cannot be published promptly or in full. This undertaking will be carried out with the co-operation of existing scientific journals and societies. The plans of the new division are outlined in a paper read by Mr. Watson Davis, director of Science Service, before the thirteenth Conference of the Institut International de Documentation at Copenhagen, September 9–14. It is considered that the scheme for the publication of scientific papers by microphotographic or similar methods should be self-supporting from the start. Possibilities of increasing the availability of existing literature by such methods are to be explored and the broad problem of scientific bibliography is also to be studied.

San Diego Natural History

SEVERAL papers recording new work have been published recently in the *Transactions of the San Diego Society of Natural History*. Vol. 8 (Nos. 6, 7, 8, 9), March 1935, contains a paper on new marine mollusca of West Mexico by Herbert N. Lowe, a description of a new trilobite from Northern California by Harry E. Wheeler, a revision of some Californian *Astrodapsis* by George L. Richards and some new species of molluscs of the genus *Triphora* by Fred Baker and V. D. P. Spicer. Both the mollusc papers deal with the shells alone, but there is in the first a good annotated list of shells collected at Punta Penasco, Sonora, Mexico. The trilobites include a very well preserved specimen

of a new *Griffithides* from the Permian Nosoni formation, its nearest known relative being *G. acanthiceps* from the Carboniferous limestone of England. A second paper by the same author discusses and redescribes the original type specimen of Vogdes' *Phillipsia* (*Griffithides*) *ornatus* from the Lower Coal measures, Conway County, Arkansas, renaming it *Griffithides conwayensis*.

Bird Sanctuaries in London

THE industry of the voluntary observers who report to the Committee on Bird Sanctuaries in the Royal Parks (England) gives a wonderfully full picture of bird-life in Greater London (Report of Committee for 1934. London: H.M. Stationery Office. 6*d*. net.). In Richmond Park, 56 species bred, and 38 other species were seen or heard; in Bushey and Hampton Court Parks, 52 species nested, including kingfisher and nightingale, and 26 others were seen. But the surprising thing is that, in the midst of the commotion of London itself—in Hyde Park and Kensington Gardens—there should appear visitors like the red-throated diver, the Slavonian grebe, and the golden-eye duck, all of them recorded for the first time in that area. It is said also that the Scandinavian form of the lesser black-backed gull appeared on the Serpentine in the autumn of 1933. Curious diversity in choice of roosting sites is shown by starlings and wood-pigeons: every evening about sunset, during autumn and winter, the latter leave St. James's Park, where there are plenty of suitable roosts, to spend the night in Battersea Park; and they make use of the very trees which some of the 2,000 starlings have sampled and abandoned before they continue their journey to roost in St. James's Park, which the pigeons have just left.

Research in the Tortugas Laboratory

THE section in the Year Book, No. 33 (1934) of the Carnegie Institution of Washington dealing with this station reports a number of workers during the season and a great variety of subjects. Although much work is done in the field, there is a notable increase from year to year in the use of apparatus requiring electric current. This will pobably necessitate the installation of a power plant of greater capacity in the future. Dr. Alan Boyden, continuing his serological studies of invertebrates, has used examples from many different phyla, including 7 molluscs, 4 arthropods, 8 echinoderms and 5 chordates. The results have been very satisfactory, and will enable light to be shed upon some of the more obscure relationships between the major groups of animals. Other researches include a study of the ecology and physiology of corals by Prof. C. M. Yonge, who found that the opportunity to examine the reefs in detail was of special value in view of his previous experience with Pacific coral reefs, and Mr. J. E. Harris's observations on the swimming movements of fishes, which embrace work on the fishes in their natural surroundings besides cinematographic experiments with special relation to their fins, whilst Prof. W. H. Longley's subject is the systematics of the Tortugas fishes.

Marine Research at Cullercoats

THE Report for the year ending July 31, 1934, of the Dove Marine Laboratory, Cullercoats, Northumberland (Armstrong College), published by the Marine Laboratory Committee and drawn up by the director, Prof. A. D. Hobson, shows it was a period of expansion of the activities of the Laboratory. The research work of the staff has been well maintained and there has been an increase in the number of outside workers. A number of alterations have been made in the building, including the conversion of a little-used lecture room into a new laboratory in which about a dozen students can be accommodated, or five research workers. This can be used for experimental and chemical work for which the main laboratory is not suitable. The work on herring has been continued as agreed with the Ministry of Agriculture and Fisheries, samples from the catches from the local shoals landed at North Shields during the season of 1933 being duly examined. Further investigations on the shoals from other parts of the coast have been continued. In Dr. Bull's work on conditioned responses in fishes, special attention is being paid to temperature, and it is found that teleostean fishes generally are extremely sensitive to temperature and that they can react to it purposively. Experiments on the perception of changes in salinity are now progressing satisfactorily. An excellent paper on the British Sphæromatidæ (Crustacea Isopoda) by Joseph Omer-Cooper and J. Hedley Rawson is included in this report. One of the species (*Limnoria lignorum*) is of economic importance as it is a wood-boring form and very widely distributed. A detailed discussion on the distribution of the Sphæromatidæ is included. In his aquarium observations Dr. Bull makes some important observations on the enemies of the common star-fish *Asterias rubens*, and shows that it is the only food eaten readily by the sun-stars *Solaster papposus* and *S. endica* and the northern stone-crab *Lithodes maia*. Adult specimens of all three can be maintained in captivity for long periods on such a diet.

British Association Mathematical Tables

PROGRESS in the publication of these tables has been rather slower than was anticipated, chiefly owing to the great labour required in correcting the proofs. Vol. 5, containing the prime factors of all numbers up to 100,000, has now been passed for printing. Tables for cyclotomy and trinomial congruences, offered by Prof. L. E. Dickson, have been accepted for publication. With regard to Bessel functions, at least three volumes will be required. The first of these (forming vol. 6 of the Tables) is now in the press, and will be published shortly. The calculations for the other volumes will absorb the greater part of the Committee's time and money during the next year.

German Chemical Industry

SHORT summaries of papers delivered at the conference of the Deutsche Gesellschaft für Chemisches

(*Continued on page* 601.)

Supplement to "NATURE"

No. 3441 SATURDAY, OCTOBER 12, 1935 Vol. 136

An Interpretation of Social Institutions

The Primordial Ocean: an Introductory Contribution to Social Psychology
By Dr. W. J. Perry. Pp. xi+380. (London: Methuen and Co., Ltd., 1935) 15*s*. net.

DR. PERRY has made a study of some of the general principles underlying the development of human society, as he regards the most pressing need of the moment to be not the accumulation of facts, but the gaining of insight into their meaning and relationships. Every man is born as a member of a community, and cannot be considered apart from his social surroundings; by virtue of his 'innate' equipment or 'biological inheritance' he reacts in certain ways to his surroundings, but he has also a 'social inheritance'.

The initial function of intelligence in the formation of society must have been closely bound up with the innate side of behaviour. Once this has been accounted for it is possible to proceed to study man's institutional behaviour and the reactions of individual qualities and behaviour to these. Dr. Perry's first inquiry is what social activities are common to the whole of mankind and what are due to special circumstances. To elucidate the first problem, he studies the food-gatherers, as representing the most primitive conditions available to us, but even among these "there are practically no social institutions", and those they have adopted from the food-producers. Many characteristics that the food-gatherers may possess in common do not depend on ethnic affinities or environment, but appear to be common to mankind.

Early food-producing was largely organised round agriculture and the domestication of animals, but accurate information is lacking how these two industries came about. Although various simple traits were carried over from the earlier condition, it was agriculture, and to a less extent the keeping of domestic animals, that led to more or less stationary groups and to living in stable communities. Hence arose the complications due to social relationships and to ritual and ceremonial observances and out of these developed religion as organised by priests. The high priests of the State cults became kings, and the royal families strove to control the whole organisation of the States. Food-production has enabled mankind to multiply enormously and has involved man in all sorts of new activities. Many social institutions have been based upon it, or greatly influenced by it. The organisation of the State, the functions of the kingship, religious ceremonial, magic, all these, according to Dr. Perry, have become associated with the great food quest.

A social institution comes into being for some definite reason: it persists for reasons that may be very different, and then a process of action and interaction is set up between it and other social institutions—human sacrifice and the wearing of clothes are examples. Painting, dancing, the drama, games, all appear to us to be 'natural', to spring immediately from innate tendencies. But the study of these activities shows that this conjecture is false. They came into play for some definite purpose, though afterwards they were practised for their own sakes.

The accumulation of possessions is not a characteristic of food-gatherers, it could scarcely be so from the nature of their life, though it is of food-producers as it emphasises status and self-esteem.

Violence is claimed to be an abnormal form of behaviour among food-gatherers: and where, as in Australia, it occurs between the moieties of a dual organisation it is assumed that the organisation has been introduced; the dual division of society is accompanied from India to eastern Polynesia by a continued hostility between moieties The earliest food-producing communities had their violent forms of behaviour strictly canalised. This violence is centred round the ruling groups, human sacrifice and associated institutions; naturally, head-hunting and human sacrifice produce feelings of revenge which leads to further bloodshed. It is asserted that it can be shown that the intensified warfare of peoples of low culture has been the result of contact with civilised people.

These are some of the themes dealt with by Dr. Perry. He also draws examples of the getting

of life, the age of the gods, the four quarters in heaven and earth, the immortal gods, and other high matters from peoples all over the world and from savage or barbarian conditions to the high cultures of the East, all of which originally were derived from Egypt. Even in Egypt no fundamental advance was made after the formulation of the propositions of the pyramid texts. Later developments in Egyptian theology consist of an elaboration of ideas already in circulation, but even with this apparent paucity of invention in later times, Egyptian religious thought seems to have dominated that of other peoples throughout the ages.

The activities of mankind are usually dominated by tradition, and this preserves the continuity of social institutions; but it does not occur to mankind as a whole to inquire into the reasons for social institutions, even when they are disassociated from practical utility or operate to the detriment of many members of the community. Tradition often blinds men to the obvious, and perverts their intelligence. Perhaps Dr. Perry has some excuse in adding that even scientific views are often accepted because they come from a trusted source, and it requires a stubborn spirit to maintain intellectual integrity.

A. C. HADDON.

Non-Religion of the Future

Psychology and Religion:
a Study by a Medical Psychologist. By Dr. David Forsyth. Pp. ix+221. (London: Watts and Co., 1935.) 7*s*. 6*d*. net.

THE opinions of a distinguished psychiatrist upon the relations of psychology and religion are of great interest and importance. Dr. Forsyth's views are quite definite: religion and science, whether psychological or other, are quite incompatible with one another, because they involve two entirely different points of view. Religion is based on 'pleasure thinking', that is, on fantasy, while science is based on 'reality thinking'. Religion in short is concerned with illusions and not with reality, and belongs, properly speaking, to the infancy of our race, and not to its maturity, and so 'should be superseded in the present stage of civilisation'.

Dr. Forsyth holds that much of the imaginative power of individuals is at present wasted in the unprofitable 'pleasure thinking' associated with religion, and that if it were not dissipated in this way, but 'purposely linked to science', it might be far more beneficial to humanity. Though at the same time he would allow this imaginative power, as at present, to be devoted to the creative arts. "Science alone does not fully satisfy, and few are not the happier and better by turning from it at times, to passively enjoy the creative activities of others in books, music, and other forms of art".

It is to be doubted whether artists and those seriously interested in their work would agree to this relegation of art to the status of a recreation provider for tired men of science and professional or business men. The artist, no less than the scientific student, regards himself as establishing contact with truth; his primary function is not to amuse people, but to enlarge their perceptions of reality.

Dr. Forsyth raises many interesting questions, and is perhaps on occasion too optimistic about the benefits that science is likely to bestow. It is indeed true that a world *wholly* guided by science would be "free from intolerance such as has marred the old religions". But when will the world be so guided, and not by the economic and political prejudices which have displaced religious? It is a bad sign that though religion has declined, intolerance in Europe has increased.

Dr. Forsyth adumbrates the revolutionising not only of our educational system, but also of the relations of parents and children, by the new psychological knowledge. The patriarchal basis of our culture does indeed seem to be giving way. Dr. Forsyth is no sentimentalist, and it would have been interesting to hear from him what is the particular neurosis lurking behind the unbalanced child-worship which has now become common. Is it failure to face the problems of maturity, and a consequent flight back to childhood?

Quite half of Dr. Forsyth's book is taken up with an examination of the relations between traditional Christianity and science. His analysis, both historical and psychological, is certainly very damaging to the traditional position. But is religion necessarily to be identified with a supernatural revelation, any more than art or science —which in primitive times were both regarded in that light, but are so no longer? And cannot psychology be used to 'debunk' science and art as well as religion?

But these are big questions. Within the limits he has set himself, Dr. Forsyth has written a very useful book.

J. C. H.

The Interpretation of Science

(1) Science in the Making
By Gerald Heard. Pp. 267. (London: Faber and Faber, Ltd., 1935.) 7*s*. 6*d*. net.

(2) Science and the Public Mind
By Benjamin C. Gruenberg. Pp. xiii+196. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 12*s*. net.

IT has become clear to most thoughtful observers that science itself has reached a crisis no less pregnant than the crisis which developed in the world at large in great measure as the culmination of the rapid and uncontrolled application of mechanical invention and discoveries in physical science. Science is being driven to help to work out a broader philosophy and to combine to make a whole of life or to accept limitations on its own restricted fields of inquiry. The restrictions being imposed under modern dictatorship are merely a foretaste of what will develop more generally, if science does not support reason and assist the other faculties which are needed to establish reason and elaborate a philosophy in which reason is not merely an accident, and understanding, judgment, impartiality, charity as well as tolerance, insight as well as analysis, are absolutely valid.

On the other side, science continues to change our lives and transform almost every condition of living. New forces are continually being released, and unless we can reach an adequate understanding of the new focus science has given us, civilisation will be smashed because we continue to use the new powers for old aims. Only the discovery of superhuman purpose can make man safe against himself when armed with his present superhuman powers.

The closing, in this way, of the gap between our rapid scientific advance and our moral and ethical development demands two things. First, the breakdown of the barriers between the different sciences so as to facilitate co-ordination and secure advance where it is most needed in the interest of the whole race. Secondly, the interpretation of science to the general citizen so that he can visualise scientific advance as a whole and understand its bearing upon the other values and activities of life upon which it impinges and with which he is engaged.

(1) Both tasks demand interpreters and it is the merit of Mr. Gerald Heard's book that, although addressing himself primarily to the layman, he to some extent performs the first task also. In fact, whatever claims the original broadcast talks, on which the book is based, may have had to the title "Science in the Making", in their expanded form, the title is clearly a misnomer. There are no descriptions of technique and singularly little indication of the way in which science is built up; the book would have been more happily entitled "The Interpretation of Science". Despite a style which some will find mildly irritating, Mr. Heard has done his work well, though his references to Leakey's theories might have been more guarded. He has at any rate pointed the way, and the book may well inspire some scientific specialists to take a greater interest in science as a whole and in a scientific attitude to life in general. Is it too much to hope that it may induce others to consider more closely the social consequences of their work and to attempt its interpretation?

(2) "If society is to maintain its health and sanity, the public at large must either be trained to accept the guidance and direction of a special class . . . or else it must be trained to take part in the knowledge, the culture, the thought, the concepts upon which its civilisation rests." In these words, Dr. Gruenberg indicates the real choice before us in regard to educational policy and his own reason for presenting his study of the place of science in relation to adult education.

Although much of the material is drawn from American sources, the breadth of vision and the extent of the survey give this book real value to all who are concerned with the problems arising out of the impact of scientific discovery on society and our ability to master the new forces placed at our disposal. Dr. Gruenberg gives an admirable and concise statement of the problems which are involved in the education of society as a whole as to the value of science and its true contribution in thought and life. Whatever may be the fate of democratic government, its fullest possibilities can only be realised through a community thinking continuously and effectively according to the essential scientific method, with all that it implies of wide and clear vision, the recognition of the need for inquiry upon great questions and the settlement of problems upon the basis of facts and logic.

Scientific workers who have any concern with the interpretation of the results of scientific investigations to the community or with the consequences of their own discoveries cannot fail to find Dr. Gruenberg's analysis of the situation highly suggestive whether in treating of the failure of science to reach the public, the means and methods of bringing science before the public, or in his recommendations for future efforts in this field.

R. BRIGHTMAN.

Sociology in the United States

Race and Culture Contacts

Editor: E. B. Reuter. Contributors: Romanzo Adams, W. O. Brown, E. Franklin Frazier, Max Handman, Asael T. Hansen, J. O. Hertzler, Charles S. Johnson, Andrew W. Lind, R. D. McKenzie, Robert E. Park, John A. Rademaker, Edward B. Reuter, Jesse Frederick Steiner, Clark Wissler. Pp. viii+253. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 18*s*. net.

IN the United States, students of racial questions have the advantage—or disadvantage according as it is regarded—of finding their problems very much at their doors. This undoubtedly is responsible for a characteristic realism in approach, which finds extreme expression in a marked addiction to questionnaires, but, at the same time, is not always conducive to academic calm and detachment in discussion. As might be expected, however, anything in the nature of racial feeling is commendably absent from the papers which compose this volume. On the other hand, more than half the contents is taken up with the consideration of conditions which directly affect the United States, specific problems in the social structure of to-day. This is not without significance in a book which is intended for a wider public than the professional audience to which the papers were originally addressed.

Prof. Reuter has selected for inclusion in his volume fourteen of the papers which were presented at the twenty-eighth annual meeting of the American Sociological Society, prefacing them with an introductory chapter in which he outlines for his non-professional readers certain general considerations. In his selection, he has been influenced by the fact that most of the communications which follow—in fact all with one exception—are descriptive and historical, rather than theoretical, in character. They are arranged in a logical order, which follows the sociological argument of equilibrium—contact—maladjustment—equilibrium. Hence the papers fall more or less into two groups, an earlier which covers the beginnings of racial contact and conflict and is concerned largely with Old World conditions, and a second in which, as already mentioned, are described the adjustments partial or complete of American contacts—Negroes, Orientals settled in America and Hawaiians; Prof. Clark Wissler, in an able analysis of development in pioneer days affecting the culture and status of the American Indian, occupying something in the nature of an intermediate position.

In the first and more general section, it must not be held invidious to select for mention two papers, one a general survey of conditions in three continents by Mr. Robert E. Park, which is of especial interest to British readers for what it has to say of South Africa and India, and a study by Dr. Max Handman of adjustments between conflicting elements as exemplified in Transylvania.

Turning to the papers dealing with problems directly affecting the United States, English readers will find much here to interest them, written from an intimate point of view and with authority. One fact immediately calls for notice. That is the effect of the common school system. Both Mr. J. F. Steiner and Mr. John A. Rademaker, who deal with the settlement of Orientals in the United States, agree that, notwithstanding the difference in attitude of the first generation of Chinese and Japanese, the former still clinging to the tie of their native land, the racial barriers between American and Oriental tends to break down in the second generation under the influence of the association in early life at school.

Educational influence is also affecting the Negro problem, though in a different way. Mr. C. S. Johnson points out how the rising generation is now bringing about a modification in the Negro outlook, and it is probable that this is the influence which is largely responsible for the grades into which Mr. E. Franklin Frazier classifies the types of Negro family. His paper is a very interesting study of what is in effect a society within American society, which is governed by an entirely different social code. Mr. Frazier finds four types of Negro family organisation, of which, that which for purposes of distinction might be called the primary form, is purely matriarchal on primitive lines, the man being entirely absent or unimportant. This, however, is not a relic of an African matriarchal system inherited from slave ancestors, but a survival of pre-emancipation days, in which conditions, economic and social, favoured and tended to stabilise the position of the woman in independence of her male Negro consort. Post-emancipation conditions perpetuated this state of affairs, except in the case of the more skilled or well-to-do men.

The volume closes with a contribution by Mr. A. W. Lind on Hawaii, carrying further evidence in an earlier essay by Mr. Romanzo Adams. Both point to the conclusion that in Hawaii racial contacts have reached a phase of equilibrium,

although not without a note of warning that naval and other professional or official gradings may introduce a note of disharmony. Historical causes, which are here ably analysed, have brought it about that in all personal associations racial feeling is entirely absent. Americans, Hawaiians and Orientals associate on equal terms and without afterthought. Thus the book closes with the comforting thought for the practical sociologist that in one spot, at least, in a world-wide survey, a solution of the racial problem seems to have been attained.

A Psychology of Conduct

The Psychology of Wants, Interests and Attitudes By Edward L. Thorndike, and the Staff of the Division of Psychology of the Institute of Educational Research, Teachers College, Columbia University. (Century Psychology Series.) Pp. x+301. (New York and London: D. Appleton-Century Co., Inc., 1935.) 10*s*. 6*d*. net.

IT seems perfectly obvious that factors which in common conversation are called wants, interests, attitudes, desires, motives, tendencies and feelings influence human action, and perhaps the behaviour of all animals, more powerfully than any others. For many reasons, however, factors of this kind are not easy to study experimentally in an adequately controlled manner, and comparatively little is known definitely about the ways in which they operate. Many years ago, Prof. E. L. Thorndike began to develop an experimental technique for studying these 'satisfiers' of action, as he now calls them, and he soon arrived at the view that they operate, not only in a prospective manner, tending to establish connexions between particular reactions in a series, but also, retrospectively, strengthening or weakening connexions once set up. In this book he, and a number of his students, present and discuss the results of their most recent studies of the general problem of the effects of specific tendencies upon behaviour.

A want may lead a person to act in a specialised manner the very first time it is aroused. But when the same want has been aroused a hundred times, the resulting action may be very different. This difference, Thorndike says, is due to two things: the backward influence of the want, and changes in the wants, and connexions of wants, themselves. These are his two main problems: how can wants, interests and attitudes act in a backward way upon the series of acts which satisfy them? Also how are they "strengthened, weakened, and shifted in their attachments"?

It is not possible, in a brief notice, to describe in any detail the mass of ingenious experimental dodges used by Thorndike and his collaborators. All of them in this book concern human action, and particular questions asked and answered are: How does a want determine what response a situation is going to evoke? How does it settle what response is going to survive? What is the precise influence of reward and punishment? Is there any real difference between learning to know or to do things that are valuable and things that are useless? It is now regarded as more than ever certain that wants, and the like factors, do somehow work backward, strengthening the bonds between acts that lead to their satisfaction. Further, some progress is made with the job of saying in detail how they do this, though the physiological mechanism involved—and Thorndike is quite sure that there is one—remains obscure. Apparently punishments are not of vast direct significance, though they can turn aside the agent to some course of action that is a genuine 'satisfier'. The experiments on the direct influence of interests on learning and doing are perhaps a little less convincing than some of the others, but from them it appears that the common belief that interest aids both is justified, but exaggerated; while if interest is present, whether what has to be learned is useful or not seems to make very little difference indeed.

The second part of the volume, dealing with the changes that may take place in wants, interests and attitudes in the course of experience, is not less important than the first. Again, rewards bulk largely in the discussion. What is the effect of a reward, near, or remote, emphatic, or weak? How are wants affected by being tied up with particular stimuli and situations by a conditioned reflex method? What precisely happens when a stimulus, being unpleasant, is nevertheless often repeated? A final chapter discusses difficulties in the education of wants, interests and attitudes, and appendixes give adequate samples of the experimental methods used throughout, and their results.

The volume as a whole is an extraordinarily interesting piece of pioneering work. It is original, both in design and in execution. It should point the way to a host of investigations, by relatively controlled methods, of intensely important theoretical and practical questions which hitherto have been mainly merely a field for conflicting speculations.

F. C. B.

Fracastor's Poem on Syphilis

Fracastor: Syphilis, or the French Disease; a Poem in Latin Hexameters
By Girolamo Fracastoro. With a Translation, Notes and Appendix by Heneage Wynne-Finch. Pp. vii+253+4 plates. (London: William Heinemann (Medical Books), Ltd., 1935.) 10*s*. 6*d*. net.

IN the introduction to this scholarly work, which admirably illustrates the close relation of medicine with literature, Mr. James Johnston Abraham, who is not only a well-known specialist in venereal diseases but also a writer of distinction, gives a short sketch of the life and times of Fracastor, and the origin and treatment of syphilis from the time of Fracastor until the present day.

In the preface to his translation, Mr. Heneage Wynne-Finch lays stress on the literary charm of the poem, which he declares has lately been neglected or obscured, though he admits that Fracastor occasionally indulges in tedious repetitions and redundancies. The poem, however, received the highest praise from contemporary writers such as Cardinal Bembo, the Venetian poet, to whom it is dedicated. Moreover, the popularity of the poem is shown by the fact that after its first appearance in 1530 at Verona, thirteen editions were published in the course of the sixteenth century.

Of Mr. Wynne-Finch's translation, which, unlike Natum Tate's verse rendering of 1686 is in prose, it may be said that he has admirably succeeded in his aim of retaining the grace and charm of the original, while keeping fidelity to the text.

The poem, which consists of three books, relates how a shepherd named Syphilus incurred the wrath of Apollo, who punished him by the infliction of a highly contagious and terrible new disease. A vivid description of the hideous sores and deformities of the unhappy victims is given in the first book, while the last two are mainly devoted to treatment, particularly by guiacum, on which Ulrich von Hutten had lavished such undeserved praise, and mercury.

The translation is followed by an essay on Fracastor and Virgil by Mr. Vernon Rendall, who illustrates by numerous examples Fracastor's use of Virgilian idiom and language as well as his resemblance to his master in his appreciation of the beautiful Italian country. Like Mr. Wynne-Finch, however, Mr. Rendall is not blind to Fracastor's shortcomings, and notes particularly the servile manner in which he takes incident and detail as well as words and phrases from the "Æneid". Mr. Rendall has also assisted Mr. Wynne-Finch in the preparation of copious notes on the poem, which include an abridged translation of the chapters on syphilis in Fracastor's other most important work, "De Contagione".

The book, which should appeal to all who are interested in the history of medicine or literature, is illustrated by portraits of Fracastor, facsimiles of pages from the first edition and first English translation and woodcuts of fifteenth century works on syphilis.

Penetrating Ocean Depths

Half Mile Down
By Dr. William Beebe. Pp. xix+344+88 plates. (London: John Lane, The Bodley Head, Ltd., 1935.) 18*s*. net.

DR. WILLIAM BEEBE is the born adventurer. To him the thrill of arriving where man has never arrived before is an unfailing stimulus to further exploits. When he turns from the tropical jungle and the desert to the ocean he does not rest until, inside a hollow steel ball, he has penetrated its depths to a distance of 3,028 feet beneath the surface. Even as he is making his hazardous journey down into the unknown the messages he sends along the telephone line to the surface reveal the driving spirit of the venture:

"We have just splashed below the surface."	
"We are at our deepest helmet dive."	60 ft.
"The *Lusitania* is resting at this level."	285 ft.
"This is the greatest depth reached in a regulation suit by Navy divers."	306 ft.
"We are passing the deepest submarine record."	383 ft.
"The *Egypt* was found at this level by divers in rigid shells."	500 ft.
"A diver in an armoured suit descended this far into a Bavarian lake—the deepest point which a live human has ever reached."	525 ft.
"Only dead men have sunk below this."	600 ft.
"We are still alive and one-quarter of a mile down."	1,426 ft.

Dr. Beebe is also a talented writer, so that when he comes to record his experiences, his free and personal style of presentation ensures the production of a readable narrative. There are few who cannot enjoy a well-told story of adventure.

In his latest book, "Half Mile Down", however, Dr. Beebe would seem to wish to draw the reader aside from the material facts of scientific adventure under sea in order to contemplate the æsthetic delight of such work. He therefore starts with an extract from William Morton Wheeler's "Entomologist in Hades" as his Apologia, in which the 'correct' investigator with his constant striving to solve 'problems' is contrasted with the amateur who is "permitted to roam at will among the fragrant asphodels of the Elysian meadows, netting gorgeous, ghostly butterflies until the end of time". And in the arrangement of the text he creates four divisions, the first of which is entitled "Emotional", and the last "Technical". Even so, before seven pages of the text are completed, the uncontrollable spirit of the real adventurer breaks out once more and Beebe is telling us that "in my present existence there is only one experience left which can transcend that of living for a time under the sea—and that is a trip to Mars".

In these circumstances the book is a difficult one for the reviewer. For it is neither a straight story of adventure under sea, nor a scientific manual, but rather an odd admixture of fact and imagination. Nevertheless, it may be said to consist of a popular narrative, complete in the first 225 pages, and a series of technical appendixes, filling the remaining one hundred or so pages to which the student may turn for the more prosaic scientific data of exploration. There is much to interest everyone in the narrative, including a history of deep-sea diving from ancient times to the present day, and there are many fine illustrations and reprints. The eight technical appendixes deal with the construction of Mr. Barton's original bathysphere of 1930 and its modifications in 1934; a bibliography of the history of diving; a catalogue of unedited telephone observations made during actual dives of the bathysphere; a classified résumé of organisms observed; and a final summary of conclusions relating to physical conditions at the greatest depths, temperature, pressure, clarity of observation, and biological observations on the abundance, illumination, activity, size and vertical distribution of oceanic organisms.

A Modern Description of World Vegetation

Pflanzengeographie auf physiologischer Grundlage

Von Prof. Dr. A. F. W. Schimper. Dritte, neubearbeitete und wesentlich erweiterte Auflage, herausgegeben von Prof. Dr. F. C. von Faber. Band 1. Pp. xx+588. Band 2. Pp. xvi+589–1612. (Jena: Gustav Fischer, 1935.) 90 gold marks.

TWO books published at the end of last century undoubtedly laid the foundations of modern plant ecology—Warming's "Plantesamfund", made available to the majority of international readers through Knoblauch's German translation published as "Lehrbuch der Oekologischen Pflanzengeographie" in 1896, not appearing in English until much later (1909) in an enlarged but not nearly so satisfactory a form; and the original edition of the work under review, Schimper's "Pflanzengeographie auf physiologischer Grundlage" (1898), which was fortunately translated into English with less delay (1903). The two authors presented their material from somewhat different points of view, but both were masters of their subject, both had travelled widely in the tropics as well as in temperate regions, and both gave thorough systematic accounts of what was then known of the field. Warming's book was quite short, unillustrated and adopted a somewhat limited, though thoroughly instructive, guiding principle. Schimper's was much longer, more discursive, illustrated by a great number of excellent photographs of vegetation and drawings of characteristic plants, and was indeed at the time of its publication a veritable mine of information previously unavailable to the student. It was somewhat vitiated, however, by certain physiological theories which have proved untenable in the light of later research.

It would be difficult, and not relevant here, to attempt to estimate the relative influence of these two books on the subsequent development of the subject. Together they have stimulated innumerable investigations, and have formed worthy foundations for the immense, though still rather inchoate, superstructure that has been built upon them during the last thirty-five years. There have also, of course, been other creative influences at work, of which the most important has been the increasing conviction of the universal validity and fundamental importance of the 'succession' or 'development' of vegetation, which we owe mainly to the work of the American ecologists, Cowles

and Clements. At present, there is great activity over the whole field almost throughout the world, not least in the Continental countries, in almost all of which there has been a notable revival of interest since the War, largely due to the influence of Braun-Blanquet.

The fundamental value of the modern type of work for application to the great practical problems of land utilisation, recognised many years ago in some countries, for example, the United States and New Zealand, is being slowly—much too slowly—appreciated in the British Empire. It is not too much to say that if this kind of work were adequately endowed, actively prosecuted and the results properly applied, the avoidance of wasteful exploitation of land in 'new' countries would eventually represent a stupendous saving in money alone. Ecological survey is in fact the pre-requisite of that intelligent 'planning' on a large scale which is becoming more and more urgently necessary in the modern world.

Prof. von Faber has now presented us with a new, greatly enlarged, and almost completely rewritten edition of Schimper's great work, taking into account the immense number of investigations which have been carried out during the present century. He has maintained the general plan of the original book, beginning with a description of 'ecological factors', to which 260 pages are devoted. This is a good and fairly thorough, if rather pedestrian, account, in which the more modern work is adequately treated. The author then proceeds to consider the major units of vegetation, the so-called 'plant formations'. Here he maintains Schimper's distinction between climatic and edaphic formations, and ignores the views of Clements, who considers that edaphic formations are always stages in the development, or modifications, of the climatic formations. Prof. von Faber says that the controversies about the units of vegetation and their terminology are mainly controversies about names. That is partly, but not wholly, true: some of the differences arise from real differences of interpretation due to our still inadequate knowledge of the facts. The author's very brief treatment of succession, sound so far as it goes, is quite inadequate.

The third and much the longest section of the book, occupying no less than 1,200 pages, is devoted to a systematic description of the vegetation of the world and the factors which determine its multiform variations. Beginning with the tropics, of the vegetation of which Schimper's original work was the first general scientific treatment, and to which Prof. von Faber's own observations have contributed considerably, we pass to the temperate and finally to the arctic and alpine regions. Though we are still extremely ignorant of the detailed ecology of tropical vegetation, our knowledge, particularly of the physiology of tropical plants, has very greatly increased in recent years, and the author's account, both of this and of the general relations of vegetation to the characteristic tropical climates, is by far the best which has appeared. Our actual knowledge of the detailed constitution of the most characteristic of all—the equatorial rain forest—is now being put on a firm basis by the work of Mr. Paul Richards, who is at present following up his thorough investigations of small samples in British Guiana and Sarawak by studies in West Africa.

When we turn to the vegetation of temperate regions, we find Prof. von Faber's account, as was almost inevitable, far less satisfactory, though it includes a number of valuable discussions and summaries. An adequate handling of the enormous quantity of material provided by the studies of innumerable observers in Europe and North America is very nearly an impossible task, not merely on account of its sheer bulk, but also mainly because the observations have been made from so many different points of view, with widely varying accuracy, thoroughness and technique, so that very many of the results cannot be correlated and unified. We cannot complain that the author has neglected the literature. Though his citations are necessarily and confessedly far from being exhaustive, he has referred to a great range of representative work in all the principal countries. But the result leaves a somewhat confused and chaotic impression on the mind, and that is not surprising. Probably the only effective way to write a scientific description of world vegetation would be to adopt a specific point of view, and to neglect all work which did not provide data suitable for its elaboration. The active and widespread work of Braun-Blanquet's school is in this direction, though some of us may be a little sceptical as to the complete soundness of its foundations.

With minor mistakes and misapprehensions in so large a book—and many such the most indefatigable and accomplished author could scarcely be expected to avoid—it is naturally impossible to deal, but we regret to see that in the world map showing the distribution of the main types of vegetation the British Isles is even more fantastically divided than in most of the maps published by Continental authors. The book is illustrated by three folding maps and 613 figures, mostly beautiful photographs of typical vegetation excellently reproduced. When all criticisms have been made, Prof. von Faber's edition of Schimper remains an exceedingly valuable work, which will be indispensable to all students of the subject.

A. G. TANSLEY.

Shellac

Shellac: its Production, Manufacture, Chemistry, Analysis, Commerce and Uses
By Ernest J. Parry. Pp. xi+240. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 12*s*. 6*d*. net.

THE insect that produces the resinous material which is called shellac takes little heed of the notoriety with which its product is now invested. Financial crises of considerable magnitude have attended the failure of speculative attempts to corner the market in it, and the word has been in the mouths of thousands who have little, if any, knowledge about the material, its manufacture or its uses. It is permissible to comment on the fact that most raw materials, the production of which is limited, are liable to have the supplies cornered by vested interests and their price to the user raised accordingly. Once, however, a chemical synthesis of such materials or of a substitute for them has been achieved, the danger of a monopoly is at an end and the product can be produced in quantity without restraint, except such as arises from patent laws, and sold at a cost which bears close relation to the cost of manufacture. The urge to make synthetic products is thus a proper one economically, though, alas, the competitive struggle between natural and synthetic has often resulted in the ruin of an industry and much unemployment.

The lac industry began with the demand for the dye, the crimson lake or cochineal of commerce. Coal tar dyes superseded this; but fortunately the resin was found to be valuable first as a varnish, then as an electrical insulating material, and later for gramophone records.

Mr. Parry, who is an analyst of repute, has given us a book of wide interest covering the whole of the divarications of his subject. Starting with the origin, a full account is next given of the practical production, the enemies of the lac insect and the manufacture of shellac. These sections are well illustrated.

When shellac has reached the market, the question arises of its evaluation by analysis, and it is only in quite recent years that this has been possible. Mr. Parry now treats the question at considerable length, indicating a procedure for the commercial analysis. When it comes to the chemistry of shellac, we are on less certain ground, particularly as it is a mixture, being said to consist of two parts of shellolic acid, five parts of aleuritic acid and seven parts of amorphous acids. Formulæ have been suggested, particularly by Harries and Nagel, for these two acids.

The chapter on the commerce of lac introduces a number of subjects, such as the rights of landowners in India, marketing up to the Calcutta merchant shippers, the London trade, contracts: the expert must know something of all these. In an appendix, the author's original papers are included, largely dealing with adulteration, also the United States standards and methods of analysis, and finally a glossary of native terms.

Information is thus provided for every branch of the industry, and the seeker for knowledge about shellac is well cared for: he will, or should be, properly grateful to Mr. Parry for the trouble he has taken in making his own unique store of knowledge generally available. E. F. A.

Photoelectricity and Surface Chemistry

Electron Emission and Adsorption Phenomena
By J. H. de Boer. Translated from the manuscript by Mrs. H. E. Teves-Acly. (Cambridge Series of Physical Chemistry.) Pp. xi+398. (Cambridge: At the University Press, 1935.) 21*s*. net.

IT is surprising that there are so few books in English which deal with photoelectric phenomena. Hughes and Du Bridge's book, which made a welcome appearance three years ago, deals mainly with those aspects which are of special importance to physicists, and the only other book which has appeared recently concerning this or related subjects is Reimann's "Thermionic Emission". Dr. de Boer is therefore to be congratulated on giving us another account of this interesting subject from a novel point of view.

The object of this book is the interrelation of the adsorption of atoms on solids and the photoelectric and thermionic emission of electrons. The first two chapters are introductory, and give a short summary of the fundamental phenomena. The next part of the book is concerned with the effect of adsorbed layers on the emission from metal surfaces, while the last part deals with the photoelectric effect in insulators.

The change in the work function due to adsorbed layers is familiar ground, and Dr. de Boer has covered it well. The use of potential curves greatly

simplifies the presentation, though there is always the danger that one is tempted to seek explanations by drawing suitable potential curves instead of performing calculations, especially when the calculations are difficult. The advantages of such curves do, however, outweigh any disadvantages which their abuse might bring. This section of the book closes with discussions of the absorption of light by matter in the adsorbed state and of the selective photoelectric effect. Both these chapters are well and critically written, but occasionally one meets categorical statements on questions which are still undecided. For example, it is stated two or three times that the selective effect is an atomic effect, due to the absorption of light by the adsorbed atoms, and it is not until § 71 is read that one realises that this is merely the author's own opinion. Admittedly nearly everyone would agree that the selective effect is to be explained in this way, but this is not because the explanation fits all the facts, but because no other hypothesis seems tenable. At the moment, it is difficult to understand the enormous difference in the action of light polarised in, and perpendicular to, the plane of incidence. If the selective effect is an atomic photoelectric effect there should be no such great difference, and, on the other hand, if it is caused in any other way, it is not easy to explain the high yield of electrons.

There are three very readable chapters on photoconductivity in insulators. This difficult subject seems to become more complicated every year, and it is extremely useful to have an up-to-date account. The author takes a rather optimistic view of the subject, which is only natural in an experimental physicist. There is bound to be a certain amount of chaos when the phenomenon depends on the presence of small quantities of impurities, and perhaps the experimenter sees more of the order, while the theorist sees more of the chaos. The last three chapters discuss rectifiers and the photoelectric and thermionic properties of surfaces covered with thick layers of dielectric.

The book is a stimulating one, and should help those working on one of the subjects to appreciate what information other lines of attack can yield. The translation has been carried out adequately.

A. H. WILSON.

Binary Stars

The Binary Stars

By Robert Grant Aitken. (McGraw-Hill Astronomical Series.) Second edition. Pp. xii + 309. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

WHEN, a few months ago, Dr. Aitken retired from the directorship of the Lick Observatory and from active observational work, he had completed forty years of observation and study of binary stars. During this time he had carried to completion a survey, commenced in conjunction with Prof. Hussey, but carried on single-handed from 1905, of all stars down to magnitude 9·0 on the B.D. scale and north of 18° south declination, for the discovery of double stars; he had discovered more than 3,000 double stars with a separation not exceeding five seconds of arc; he had remeasured most of these stars, after suitable intervals, at two later epochs for the discovery of orbital motion, and had also made a considerable number of measures of known binaries. In addition, he had computed many orbits and had completed the preparation of a new general catalogue of double stars. Seldom can the energies of a lifetime have been devoted more continuously and enthusiastically to the advancement of one chosen branch of astronomy.

It is appropriate that almost the last work of Dr. Aitken before his retirement was to pass the proofs of the second edition of his monograph on the binary stars. The first edition had long been out of print, and the large amount of observational and other work in double star astronomy had made it in large part out of date. This work is well known as an authoritative and comprehensive account of all aspects of the subject. The new edition follows closely along the lines of the original edition, which has been thoroughly revised and brought up to date. The historical account of the subject is of great value and of general interest, whilst the chapter on observing methods is full of sound advice for double-star observers. Emphasis is placed on one precaution that has characterised Dr. Aitken's own observing and that has application outside this particular field: "The most important precaution to be taken in double-star observing is quite independent of instrumental adjustments. It is *to make measures only on nights when the observing conditions are good*. . . . I make this statement with all possible emphasis." Methods of orbit computation, not only of usual binary systems, but also of spectroscopic and eclipsing binary systems are described. Of special value for purposes of reference are two tables containing the elements of determined

orbits of both visual and spectroscopic systems, the authority for each set of elements being given, with a reference to the original publication.

The extensive double star surveys in both hemispheres have provided material for statistical discussion much more complete than when the first edition was published. It must have been with considerable satisfaction that Dr. Aitken was able to repeat without essential alteration the general summary given in the first edition of the more important conclusions to be drawn from the statistical material. One conclusion is of particular interest in connexion with the origin of binary systems: that there is an unbroken progression of series of orbits from systems with a period of less than a day, revolving about each other almost in contact in circular orbits to systems with periods of hundreds or thousands of years, moving in highly eccentric orbits with axes many hundreds of times the distance of the earth from the sun. The inference is that a common origin must be sought for all binary systems, and that no theory yet advanced to account for the origin and subsequent development of binary systems can be regarded as satisfactory. Down to the magnitude limit of Aitken's survey, about one star in eighteen is seen as a visual binary with the 36-inch telescope; of the naked eye stars, about one star in seven is a spectroscopic binary. The properties of binary systems is thus so high that the formulation of a satisfactory theory of their origin is one of the most important unsolved problems of cosmogony.

Short Notices

Archæology and Ethnology

The Folklore of Morocco

By Dr. Françoise Legey. Translated from the French by Lucy Hotz. Pp. 277+25 plates. (London: George Allen and Unwin, Ltd., 1935.) 12*s*. 6*d*. net.

MOROCCAN folklore, as Dr. Westermarck has shown us, is essentially a composite product. A veneer of the Moslem creed overlies a solid body of Berber magical practice and belief, in which survivals from the old Roman province are embedded like plums in a pudding. The genie, whether good or bad, common to the whole Moslem world, claims attention equally with the mysterious *baraka*, the mystic individual power of the animate and inanimate world, which is characteristic of Morocco, while in the ever-present fear of the evil eye the inhabitants affirm their Mediterranean descent.

This composite character of Moroccan belief is well illustrated in the material collected by Mme. Legey during the thirteen years of her acquaintance with Morocco, although she purposely refrains from comment on comparable beliefs and the like elsewhere. As a medical officer of the French administration, her duties and her sex have given her access to sources of information from which the ordinary observer is barred. Her record of the beliefs and practices connected with disease and its treatment and the feminine province in matters affecting birth, infancy, adolescence, marriage and its ceremonial, will be found especially valuable.

Although Mme. Legey covers the whole field of belief from ideas relating to the creation and character of the cosmos to the reverence paid to the deceased holy man at his burial-place, her contribution to the subject is most considerable in medical matters and in what is specifically the woman's world. The index, unfortunately, is not adequate to the subject-matter.

The Hill Bhūiyās of Ōrissā: with Comparative Notes on the Plains Bhūiyās

By Sarat Chandra Roy. Pp. v+320+xxxviii+17 plates. (Ranchi: *Man in India* Office, 1935.) 8 rupees.

THIS is the fifth volume in a series of monographs on the aboriginal tribes of India, which Sarat Chandra Roy has in course of preparation, on a foundation of twenty-five years experience of the peoples of the central hill belt. The present volume is concerned with one of the few tribes which show in their different branches all the various stages of evolution from the wild tribes of the hills to the thoroughly Hinduised *zamindars* of the plains, some of whom have now progressed so far as to claim Rajput or Kshatriya descent. They are distributed widely over half a dozen provinces—Bengal, Bihar, Orissa, Chota Nagpur, Assam, the United Provinces, Central Provinces and Madras. Here, however, the author deals mainly with the hill tribes who, as he notes, are correctly classified in the last census as Kolarian. Culturally, they are Pre-Dravidian.

Biology

(1) Living Things: an Introduction to Biology

By Richard Palmer. Pp. 400. (London: George Allen and Unwin, Ltd., 1935.) 7*s*. 6*d*. net.

(2) The World of Nature

By H. C. Knapp-Fisher. Pp. iv+512. (London: Victor Gollancz, Ltd., 1935.) 6*s*. net.

(1) IN being a true biology, "Living Things" makes a definite claim to freshness, and thus commands the attention of teachers. Animals and plants are in close conjunction with each other, and the author makes no attempt to segregate them artificially. Of course, this is how they should be treated:

nevertheless, the author is to be congratulated in having done what many biological authors have neglected to do.

Another fresh note is the chapter on the methods of science, which, if read by the discriminating student before and after reading the rest of the book, will prove invaluable in giving the reader the most desirable outlook on the subject. Apart from this common-sense, and therefore correct, method of treatment, it may be said that the book has an attractive style and is comparatively well illustrated. It can be whole-heartedly recommended to students up to matriculation standard.

(2) "The World of Nature" makes a different appeal: but its standard is equally high. It is more a natural history than a biology, and is written to make the world of Nature "intelligible to the ordinary educated person". We venture to say that it will not only do this, but it will also prove to the sceptical and disinterested what a fascinating field for cultural interest lies around them. There is only one criticism —a selfish one perhaps—that is, we would wish to see more of the unique but brilliantly executed illustrations.

The Botanist in Ireland
By Dr. Robert Lloyd Praeger. Pp. xii+497+44 plates. (Dublin: Hodges, Figgis and Co., 1934.) 12*s.* 6*d.*

THIS volume is difficult to classify. It is not a Flora; it is not a guide book; it is not a scientific treatise on Irish phytogeography; yet it combines features of all these into a homogeneous whole and provides those interested in the Irish flora with an ideal guide and companion for their studies and their travels. No one but Dr. Praeger could have written such a work, and it is indeed a fitting crown to his life-long labours on the flora of his native land.

The work is divided into four parts. The first comprises sections on the physiography, geology, topography and climate of Ireland, each a model of compression and clear statement. The second contains notes on various miscellaneous aspects of the flora, including topographical and ecological distribution, and an invaluable list of rare or interesting Irish plants, in which information hitherto scattered in periodicals has been brought together.

The main part of the book is devoted to a topographical survey of the whole country, with a full description of the flora of each area. Dr. Praeger's intimate knowledge of every square yard that he describes gives to these pages a remarkable vividness which must be unique in botanical literature.

The concluding section consists of a census list of the flora, with the distribution of each species indicated by numbers referring to the counties in which it occurs. There is an excellent index.

The whole volume is copiously illustrated with maps, diagrams and photographs of individual plants and botanical localities. The photographs, most of which were taken by Mr. R. Welch, are extraordinarily beautiful, and add greatly to the value of the book.

Elementary Microtechnique
By H. Alan Peacock. Pp. vii+200. (London: Edward Arnold and Co., 1935.) 5*s.* 6*d.* net.

THIS small book should prove of value to the amateur and elementary biologist, and the more advanced student and laboratory worker may well add it to his reference library, for it contains a number of practical hints and useful dodges and recipes. The matter presented is concisely given, largely in tabular form. After some introductory remarks on protoplasm and cytology, the processes and principles of microtechnique and methods for making microscopical preparations are considered. A chapter follows on technique, including fixing, hardening, embedding and sectioning, staining, and mounting, with a section on bulk staining. The next chapter deals in alphabetical order with methods for specific purposes for animal and plant organisms and tissues, and contains a surprising number of headings, ranging from acarine disease of bees and annelids to *Vorticella* and yeast (rotifers do not seem to be mentioned here). The next chapter gives the use of stains, followed by one containing the formulæ.

Ink for writing on glass is not given, while grease pencils are so easily obtained that the method for making them might well be omitted. Similarly, such agents as Farrant and glycerin jelly are probably better purchased than made, and the same applies to eyepiece scales and micrometers. The remarks on numerical aperture may give rise to confusion, as the term "definition" is used, instead of the correct one, "resolution". A most useful appendix gives the sources from which the organisms and tissues mentioned may be obtained, and their preservation is dealt with in another appendix.

R. T. H.

Chemistry

Organic Syntheses:
an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Carl R. Noller, Editor-in-Chief. Vol. 15. Pp. v+104. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 8*s.* 6*d.* net.

THIRTY substances are included in the current volume of this welcome annual. Among acyclic compounds with long carbon chains are *n*-dodecyl bromide (made from *n*-dodecyl alcohol), *n*-hexadecane (from cetyl alcohol, via cetyl iodide), and oleyl alcohol (from butyl oleate, prepared from olive oil by alcoholysis). Simple open-chain compounds include trichloroethyl alcohol, which is readily prepared by treating chloral with aluminium ethoxide in presence of anhydrous alcohol. In the aromatic series, a simple method is given for converting 2,4-dinitrochlorobenzene into 2,4-dinitroaniline by treatment with ammonium acetate and ammonia gas at 170° in an open vessel; further, an example of oxidation with selenium dioxide is provided by the preparation of phenylglyoxal from acetophenone. In the heterocyclic series, Hans Fischer submits details of the preparation of 2,4-dimethyl-3,5-dicarbethoxypyrrole and its conversion into 2,4-dimethylpyrrole,

by means of processes based upon the original procedure of Knorr.

Improved methods of making two simple reagents of wide use in organic chemistry are also included. There is, in the first place, an illustrated description of a useful laboratory apparatus capable of producing 300 grams of anhydrous hydrogen bromide per hour by the direct combination of hydrogen and bromine. Secondly, an account of Arndt's recent method for preparing diazomethane will be of service to users of this valuable synthetic reagent. Methyl urea is made from methylamine hydrochloride and potassium cyanate; alternatively, aqueous ammonia and dimethyl sulphate may replace the methylamine hydrochloride. Treatment with nitrous acid furnishes nitrosomethyl urea, which is then subjected to the action of aqueous potassium hydroxide in presence of ether. It is rightly emphasised that diazomethane is an especially insidious poison, the careless manipulation of which may induce a super-sensitive condition rendering the subject liable to attacks of asthma or fever. An appendix contains later references to preparations given in the preceding volumes. The subject index covers vols. 10–15 of the series.

J. R.

Van Nostrand's Chemical Annual:

a Hand-Book of Useful Data for Analytical, Manufacturing and Investigating Chemists, Chemical Engineers and Students. Edited by Prof. John C. Olsen. Seventh Issue. Pp. xvii+1029. (London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

In the preparation of the new edition, the editor has compared the data given in the previous edition with the "International Critical Tables", and in some cases later data than those given in this publication have been used. In all cases, critically selected values are given instead of all the values published. Many new tables appear, including those of physico-chemical data, boiling points, vapour pressures and latent heats, and tables for thermal observations and calculations.

The information contained in the book is such as will normally be required in the chemical laboratory and by the chemical engineer, and the revision appears to have been thorough and satisfactory. The manual is one which may be recommended as likely to be extremely useful, and its relatively small size will enable the user to have at his command in a very convenient form a large range of material, which otherwise would have to be sought in bulky and expensive volumes not always at hand when a figure is urgently required. It is strongly bound and should stand use in the laboratory and works.

Colloidal Electrolytes:

a General Discussion held by the Faraday Society. Pp. iv+422+6 plates. (London and Edinburgh: Gurney and Jackson, 1935.) 18*s*. 6*d*. net.

The report on the Faraday Society's general discussion on "Colloidal Electrolytes", held in London on September 27–29, 1934, is noteworthy for its very wide scope, since it includes no less than 36 papers, with discussions to which a large number of speakers contributed. Attention may also be directed to an improved binding, which appears to have been rendered necessary by the expansion of the report to more than four hundred pages (as compared with about forty pages for the first of these discussions in 1907), and to the very modest price at which it has been issued. In view of the importance of the subject with which it deals, its authoritative character, and the very favourable conditions under which it is available, it may be anticipated that the report will have a wide circulation beyond the boundaries of the Society to which the credit for its publication belongs.

The Teaching of Chemistry

By N. F. Newbury. Pp. xii+247. (London: William Heinemann, Ltd., 1934.) 6*s*. net.

The young graduate who is taking up his duties in a school will be grateful to the author for the information provided in this book, and even the experienced teacher will find something useful in it. Not all the recommendations will meet with approval, and a good deal of space is taken up by statistical information which will rapidly become obsolete. The author's recommendation that the young teacher should discard his university lecture notes and rely on elementary textbooks for his material is one which should not be followed, since in this way he is likely to use a good deal of old-fashioned and obsolete material which is perpetuated in many books.

The author, like most teachers, has his preferences, and the use of microchemical methods seems to be one. He is not always consistent: on p. 140 he says the use of formulæ and equations should be "discouraged" in the first year, whilst on p. 166 he gives a "model" answer in which a formula is used by a boy who had studied chemistry only eight weeks. These are minor points of criticism. The book is on the whole a good one, and should be found useful. The lists of books recommended, however, seem to require some extension, since some popular and successful books are conspicuous by their absence.

Engineering

Piles and Pile Driving

By A. C. Dean. Pp. x+221. (London: Crosby Lockwood and Son, Ltd., 1935.) 42*s*. net.

In his introduction to this book, the author points out that the use of piles for foundations is a practice of great antiquity. Although he does not allude to prehistoric times, it may even be claimed that it dates back to the remote period of lake-dwellers who perched their habitations on props driven into the beds of lakes. Yet, however ancient in origin, piling continues in vogue at the present day as one of the most serviceable methods of providing underground or subaqueous support for structures. At the same time, it is a branch of engineering which admits of considerable diversity of practice and opinion. Piles

are varied in character, and formulæ for driving them are numerous, with results that are oftentimes conflicting. A handbook, therefore, which brings together, for comparison, data relating to the varied forms taken by piles and the rules governing their use is a useful *vade mecum* for the engineer.

The author has covered the ground very fairly, and though in some directions, perhaps, his survey might have been amplified with advantage, yet, on the whole, it is reasonably comprehensive. It covers a brief description of timber piles, with notes on their durability and treatment, and then, at greater length, deals with the numerous varieties of reinforced concrete and steel piles, both for bearing and sheeting. There are chapters on pile-driving and the handling of disc and screw piles, followed by an informative section on the theoretical carrying capacity of piles and the stability of walls and cofferdams, in which the mathematical treatment of the subject is well set out. The book concludes with several tabular appendixes and an index. It is well printed, and the illustrations and diagrams are clear.

B. C.

Theory of Alternating Current Wave-Forms

By Philip Kemp. (A Series of Monographs on Electrical Engineering, Vol. 1.) Pp. ix+218. (London: Chapman and Hall, Ltd., 1934.) 15*s*. net.

THE invention of the oscillograph enabled electrical engineers to gain a further insight into many curious electrical phenomena. Some of these had been investigated mathematically previously, and in most cases the instrument gave a complete verification of the mathematical theory. The author begins by explaining how a periodic wave can be resolved into its harmonics. He then gives many useful mathematical theorems. He proves, for example, the conditions that the current and voltage waves must fulfil in order that the average power expended may equal the product of the effective volts by the effective amperes.

Several methods are given for harmonic analysis. Some of them assume that the function can be expanded in a finite number of sine and cosine terms having frequencies in the ratio of 1, 2, 3, etc. In fact, they give a method of interpolation that was used by Clairaut and Lagrange seventy years before Fourier published his theorem. We doubt whether it is possible to compute the amplitude of the 25th harmonic when the half base is divided into only twenty-six parts and the ordinates measured. Using Lagrange's solution and applying it to a rectangular wave, we find that the computed value of the amplitude of the eleventh ordinate when the half base is divided into twelve equal parts is only one fifth of the true value. Applying Hardy's rule directly to Fourier's solution in this case, the error in the amplitude of the eleventh harmonic found is less than three per cent. We think that by far the best and least laborious method of finding the amplitudes and the phases of the various harmonics is to apply some of the known methods of graphical integration to Fourier's solutions.

Problems in Electrical Engineering, with Answers

Edited by Prof. S. Parker Smith. Second edition, revised and enlarged. Pp. xiv+210. (London: Constable and Co., Ltd., 1935.) 5*s*. net.

A BOOK containing more than a thousand somewhat difficult problems, the answers to which are all given, represents a great deal of labour. It also shows that, to a first approximation, electrical engineering has become an exact science. This book will be a help to all teachers of electrical engineering, especially in their exercise classes. The students attempt the examples which have been set and the teacher goes round the class and helps them individually. The examples are suitable for a three years college or university course. As a guide to the students, the easier examples are marked with an asterisk. We congratulate the editor on having produced such a useful book.

Geography

The Fiord Region of East Greenland

By Louise A. Boyd, with Contributions by J. Harlen Bretz, O. M. Miller, Walter A. Wood, William B. Drew, Charles B. Hitchcock and John K. Wright. (American Geographical Society, Special Publication No. 18.) Pp. xii+369+14 plates. (New York: American Geographical Society, 1935.) 4 dollars.

MISS L. A. BOYD, with the help of the American Geographical Society, organised and led an expedition to the Franz Josef and King Oscar fjord regions of East Greenland in 1933. The primary object was the study of fjord formation. This composite volume gives the important results of the work.

After Miss Boyd's narrative, with much good descriptive work, comes a study of the origin of the fjords by Prof. J. H. Bretz. He finds them to be stream-eroded valleys modified by glacial action, and in only one valley does he find clear evidence of fault action. Post-glacial frost action is very marked but not more on the coast than elsewhere, which possibly may be explained by the constant rising of the land. There is no strand flat in Greenland, but nevertheless Prof. Bretz believes that Nansen's theory of the strand flat formation by the product of wave action and frost action receives some support from Greenland.

The volume contains several new maps, many oceanographical data and a large collection of superb illustrations. A chapter on the botany of the region, as well as Jan Mayen, is important. R. N. R. B.

World Sugar Production and Consumption: an Economic-Geographical Survey

By Dr. C. J. Robertson. Pp. vii+142. (London: John Bale, Sons and Danielsson, Ltd., 1934.) 5*s*. net.

DR. ROBERTSON'S present association with the International Institute of Agriculture at Rome has ensured an adequate use of statistics in this book whilst his training in the University of London has given it a viewpoint which will render it of considerable value, as a convenient summary, to economists and geographers. After reviewing the general conditions of

cane and beet-sugar production, he treats each major producing area in turn, stressing the variations in unit-yields from one area to another. The huge expansion in consumption which is considered possible could largely be met by increasing the yields in Cuba (2–3 tons per acre) or India to those of Java which have risen from 1·1 to 6·5 tons in the last century. The Indian statistics cease with 1932–33, but the recent expansion is predicted. It is considered that if protection were removed, beet-sugar would practically disappear. L. D. S.

Europe: a Regional Geography
By Margaret Reid Shackleton. (University Geographical Series.) Pp. xvi+430. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 15*s*. net.

BEHIND the freshness of the writing and the sometimes almost casual treatment of a wide field there is evidence of extensive reading, a sympathetic understanding and not infrequently of an acute perception reminiscent of L. W. Lyde at his best. This is not a school book, nor is it an adequate university textbook, but it may be cordially recommended to all who have been accustomed to, and have perhaps tired of, the formal presentation of the facts of European geography and who seek a broader view in the understanding of current problems. Britain is excluded from consideration.

Mathematics

The Differential Calculus
By Theodore Chaundy. Pp. xiv+460. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 35*s*. net.

THERE has long been a need for a modern English textbook on the advanced parts of differential and integral calculus. The older books were comprehensive in scope, but deficient in rigour; the newer ones give a careful discussion of limits and continuity, but they ignore such topics as Jacobians and maxima and minima of functions of two independent variables. Many years ago, Mr. Chaundy started to write a differential calculus which should combine the English plan with Continental rigour, but in the course of time it has developed into something rather difficult to classify.

The book is intended to be a complete and self-contained treatment of the differential calculus so far as it concerns the real variable, excluding applications to geometry and mechanics. It would have been more convenient to students if the author had abandoned his attempt to be self-contained, an ideal not fully attained, as on p. 14 a rather difficult theorem on limits is quoted from Bromwich's "Infinite Series". The contents of Hardy's "Pure Mathematics" might reasonably have been assumed to be known to every student of higher mathematics; by taking this as a starting point, Mr. Chaundy could have made his book much shorter and cheaper.

There are fourteen chapters, dealing respectively with functional dependence, the continuous function (two), the derived function, higher derivatives, partial differentiation, indeterminate forms, analytic functions, maxima and minima (two), implicit functions, Jacobians and Hessians, differential operators, and expansions in power series. Many parts are of great interest, and some of these contain information difficult to find elsewhere. New terms are introduced, such as "vanishingly uniform convergence", and "umbral derivative", and there are several variations from the orthodox notation, some of which seem to be improvements. There are about four hundred carefully chosen examples, and a detailed index.

Lectures on Matrices
By J. H. M. Wedderburn. (American Mathematical Society Colloquium Publications, Vol. 17.) Pp. vii+200. (New York: American Mathematical Society; Cambridge: Bowes and Bowes, 1934.) 3 dollars.

THE calculus of matrices has had a curious history. It was first used by Hamilton in 1853 under the name of "Linear and Vector Functions". Cayley used the term matrix in 1854, and developed the basic notions of the theory in 1858 without recognising the relation of his work to that of Hamilton. The algebra of matrices was rediscovered by Laguerre in 1867 and by Frobenius in 1878. Sylvester wrote a large number of papers on matrices, especially in the years 1882–84. After this, although the subject was never entirely dropped, it certainly seemed for many years to be regarded as of little interest to mathematicians in general. Then suddenly came a change. In 1925 Heisenberg's quantum mechanics created a widespread interest in matrices among physicists and applied mathematicians. It is significant that in the bibliography given at the end of the book under review, the average number of entries for 1853–1924 is 5·3 a year, rising to 18·3 for the years 1925–33, although the basis of selection has been narrowed for the later years.

Dr. Wedderburn's book is founded on lectures given at Princeton University at various times since 1920. It contains ten chapters, dealing respectively with matrices and vectors, the characteristic equation, invariant factors, vector polynomials, compound matrices, Hermitian matrices, commutative matrices, functions of matrices, automorphic transformations, and linear associative algebras. The subject is treated from the point of view of pure mathematics, without any explicit reference to physics, but some of the topics may easily be recognised as those which are of great importance in quantum mechanics.

Generalized Hypergeometric Series
By Dr. W. N. Bailey. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 32.) Pp. vi+108. (Cambridge: At the University Press, 1935.) 6*s*. 6*d*. net.

THE ordinary hypergeometric series, discussed by Gauss about a century ago, is well known; it is a function of three parameters, of which two occur in the numerator and one in the denominator. In the

generalised series, the number of the parameters in the numerator and denominator may be anything we please. Until comparatively recently, it was difficult to obtain anything like a complete grasp of the scattered work on these series. Cayley, in 1858, published, without proof, a theorem which he had inferred from considerations of planetary theory, and it was not until forty-one years later that a proof was discovered (by W. McF. Orr). Ramanujan rediscovered for himself many results already known but not accessible to him. The first systematic account of the subject was contained in Hardy's paper, "A Chapter from Ramanujan's Note-book" (1923). Since then numerous papers have been published, and at the suggestion of Prof. L. J. Mordell this tract, dealing largely with recent work, has been prepared by Dr. Bailey, who has himself played a leading part in the development of the subject.

At a meeting of the Mathematical Association some years ago a speaker introduced the terms 'purist' and 'fusionist'. Dr. Bailey is evidently a purist, who keeps to the straight and narrow path of his subject, and sternly resists the temptation to stray into attractive cross-roads. As the preface points out, "all parts of the subject, such as asymptotic expansions, which definitely belong to function theory, have been deliberately ignored". It is difficult for a reviewer with fusionist prejudices to approve of this policy, but in all other respects the tract may be commended. H. T. H. P.

Miscellany

The Subject Index to Periodicals, 1934

Issued by the Library Association. Pp. xii+283. (London: The Library Association, 1935.) 70*s*.

THE editor, Mr. Rowland Powel, and his voluntary contributors, are to be congratulated on having succeeded in publishing this subject index to the contents of periodicals that appeared in 1934 some six weeks earlier than was the case with the corresponding volume last year.

The entries in the index are taken from 539 English and American, 26 French and Belgian, 21 German and 2 Italian periodicals. In the list of periodicals indexed, fuller bibliographical information is now given, including name and address of the publishers, frequency of publication and price (where possible). It is hoped that these details will enable those who make use of this subject index to procure a copy of any particular paper they may wish to possess.

Since last year, the selection of French and German periodicals indexed has been carefully revised, with the object of making the list more useful and comprehensive.

With few exceptions, no attempt has been made to index periodicals covered by the following publications: *Agricultural Index, Engineering Abstracts, Engineering Index, Index Medicus, Journal of the Society of Dyers and Colorists, Photographic Abstracts, Revue de Géologie, Royal Meteorological Society, Science Abstracts, Textile Institute Journal.*

The fact that this is the ninth year of the publication of this subject index in its present form is evidence that the index is widely recognised as an aid in the difficult process of finding what has already been published on any particular subject. We hope, indeed, that the Library Association will make this index a permanent feature of its activities.

Fifty Years in Public Health:

a Personal Narrative with Comments. By Sir Arthur Newsholme. Pp. 415+11 plates. (London: George Allen and Unwin, Ltd., 1935.) 15*s*. net.

IN this volume, Sir Arthur Newsholme records his recollections, mainly limited to occurrences bearing on public health, from childhood down to the year 1908, when he was appointed to the Local Government Board, as it then was. This period, covering the time when he was in general practice and later medical officer of health of Brighton, was one of great development in preventive medicine, for it witnessed the growth of the science of bacteriology from the beginning, the institution of important administrative measures in public health, and profound changes in epidemiological theory.

Sir Arthur Newsholme's birthplace and home for many years was the village of Haworth, where the Brontës lived, and of whom he has some stories to tell, for some of his friends had known them, and his father had been the Rev. Patrick Brontë's churchwarden. In his student days at St. Thomas's Hospital, he came under the spell of John Syer Bristowe and Charles Murchison, notable physicians of the period, and was an onlooker on Ord's clinical researches upon myxœdema. Sir Arthur was also a spectator of the introduction of antiseptic surgery, and had the opportunity of contrasting surgical work carried out on old-fashioned lines with Listerian methods; altogether, his student days happened at a vital transition period of medical practice.

Some of the pioneers in State medicine are next considered—John Simon, Edwin Chadwick, William Farr, Benjamin Ward Richardson and others—and an outline of their work is given. Further on, we find illuminating chapters on the prevention of milk epidemics, and the control of diphtheria, typhoid fever and tuberculosis, and this interesting and inspiring volume concludes with remarks on the care of infancy and childhood, and the control of some of the diseases of the young. The book is illustrated with a number of charts, and with plates of the outstanding figures in preventive medicine of the period. R. T. H.

This English

By Sir Richard Paget. Pp. xii+118. (London: Kegan Paul and Co., Ltd., 1935.) 4*s*. 6*d*. net.

"GENETIC, as distinguished from a purely historical, philology," says Dr. Marett in his preface to this book, "can never hope to verify its guesses." Yet, as he goes on to add that Sir Richard Paget at the close of a lecture at Oxford was successful in identifying the meaning of fifty per cent of Chinese words in a test, it is evident that if his theory of the origin of language cannot be proved, it has some measure of experimental support, resting on a basis more

substantial than that subjective conviction, which is the best, as a rule, that most theories on this subject can produce.

During the last ten years, Sir Richard Paget has been engaged in elaborating a theory of the origin of language, and in collecting evidence from a wide variety of languages in support of his view that the movements of the tongue in producing certain sounds determine the meaning of the words they compose. To put it rather differently, the movements of the tongue are a variety of the sign language once widely used between primitive peoples and still, or at least until recently, surviving among, for example, the Indians of America. In this book, this principle is applied in some detail to the sounds of spoken English. One example will suffice. The sound *Sp*, corresponding with the motions of mouth and tongue in making it, expresses the meaning of a fine point as in 'spear', 'spin', 'asp' or 'wasp'.

It may be doubted how much of the author's interpretation is subjective, notwithstanding his many striking examples. This feeling grows when it is found that such terms as 'wellington' (boot), 'kit-kat' (picture) and others of a like derivation are found to fall in with the author's theories. He would explain them as a species of philological survival of the fittest.

Philosophy and Psychology

On Dreams

By William Archer. Edited by Theodore Besterman. Pp. xv+215. (London: Methuen and Co., Ltd., 1935.) 7*s*. 6*d*. net.

William Archer is best known to us as a very loyal disciple of Henrik Ibsen and the editor of the English edition of his plays. It is therefore interesting to hear his views on dreams. He is not a disciple of Freud—indeed he thoroughly disagrees with a great deal of Freudian doctrine. It is, however, often difficult to accept Freud without being analysed.

To say that Freud is "misled by three influences; first, by a love of sweeping statements, with its correlative hatred of exceptions and reservations; secondly by a very natural tendency to forget that the great mass of his evidence is gathered from more or less brainsick people; thirdly, by an unfortunate obsession, which might very properly be made the subject of study by his own methods" is, we feel, not at all an accurate criticism. We have no evidence that Freud suffers from an obsessional neurosis; if he did, he would have been analysed and cured of it while Archer was still a young man.

The author gives us, among others, chapters dealing with visions and dreams, wish fulfilment, moral sense in dreams, sources of dreams and physically stimulated dreams. He then provides us with more than sixty dreams of his own which are very interesting. Throughout the book we are constantly reminded of the fact that for a layman, however erudite, to attempt to solve psychological problems without years of training in normal and abnormal psychology is little short of sheer waste of time.

God and Creation: God, a Cosmic Philosophy of Religion

By Prof. John Elof Boodin. Pp. 240. 8*s*. 6*d*. net.

God and Creation: Three Interpretations of the Universe

By Prof. John Elof Boodin. Pp. 519. 12*s*. 6*d*. net. (New York: The Macmillan Co., 1934.)

With these two volumes, Prof. Boodin's world-philosophy takes shape definitely. His idealism, which has a strong taste of pragmatism in his earlier works, asserts itself more and more in the traditional vein inspired by Plato. The "Three Interpretations of the Universe" is a learned treatise of critical cosmology, while 'God' makes a more direct appeal to reason and the heart, in favour of a comprehensive idealist view of the universe and of Deity. In both works, Prof. Boodin shows a great earnestness of purpose, the more so as he believes that Protestantism will go on decaying theologically, unless it establishes its national foundations on the solid ground of an idealist philosophy. Even one who does not share the philosophical beliefs of the author has to acknowledge with satisfaction the masterly contribution of Prof. Boodin to the solutions of the higher riddles of the universe. T. G.

L'Année psychologique

Publiée par Prof. Henri Piéron. (Bibliothèque de philosophie contemporaine.) Année 34 (1933). Vol. 1. Pp. xxvii+432. Vol. 2. Pp. 433–1167. (Paris: Félix Alcan, 1934.) 120 francs.

We can do no more than bring to the notice of our readers this important annual publication, which gives a short but most helpful summary of all the works and memoirs on psychology published during the preceding year. The first volume contains also nine original memoirs on various problems of experimental psychology by H. Piéron, R. H. Gault, M. Foucault, C. Durup, R. Dellaert, P. Kucharski, A. Zaganczyk, S. Korngold and A. Lévy.

Physics

The Diffraction of Light, X-Rays and Material Particles:

an Introductory Treatment. By Prof. Charles F. Meyer. Pp. xiv+473. (Chicago: University of Chicago Press; London: Cambridge University Press, 1934.) 22*s*. 6*d*. net.

A proper understanding of the principles of diffraction has never been so important to the student of physics as it is at the present time, and, with this in mind, Prof. C. F. Meyer has written a useful introductory work. That portion of the book which deals with the diffraction of light is indeed an excellent example of the treatment of problems in wave optics by the graphical method of the phase-amplitude diagram. Prof. Meyer uses this elegant geometrical method almost exclusively, and succeeds in giving a very lucid, and, within the limits of the method, which in his skilful hands are wide, a very detailed account of the various types of diffraction phenomena.

The sections on the rectilinear propagation of light, and on the Fresnel and Fraunhofer diffraction phenomena follow lines which are on the whole familiar, but they gain greatly from the many excellent diagrams with which they are illustrated. Enough distinction is not, however, made between the diffraction curves giving intensity and amplitude. In several cases, for example in Fig. 83, the amplitude curve is shown as having minima of zero slope at the points of zero amplitude. The slope is as a matter of fact a maximum at these points, and the curve should strictly cross the axis.

About eighty pages are devoted to the diffraction grating, and this section contains much matter, particularly that dealing with the theory of errors of ruling, and of optical ghosts, which has not hitherto been available in a textbook.

One cannot help feeling that in the sections of the book dealing with the diffraction of X-rays and of electrons by crystals the author is less at home than he is with purely optical problems. The treatment so far as it goes is adequate, but the emphasis is not always that which a worker in the subject would have given, and opportunities for bringing out the analogies with optical problems seem sometimes to have been missed. The book, however, can with confidence be recommended to students of optics.

R. W. J.

A Treatise on Hydromechanics

Part 2: Hydrodynamics. By A. S. Ramsey. Fourth edition. Pp. xii+415. (London: G. Bell and Sons, Ltd., 1935.) 16*s*. net.

THE influence of aeronautics on the academic hydrodynamics of a 'classical fluid' shows itself in this fourth edition of Part 2 of Ramsey's "Hydromechanics". Thus a chapter on viscosity has been added, as well as a discussion on the relation between circulation and lift of an aerofoil. There is given also some of the work due to Prandtl, Joukowski, Glauert, Jeffreys and others. Although the use of vectors or tensors has been considered and rejected, it might have been wise to follow the example of Maxwell, who in his famous treatise on "Electricity" long ago stated his results in vector form so as to give a clearer physical picture of his mathematical formulæ.

Technology

Principles of Phase Diagrams

By J. S. Marsh. (Alloys of Iron Research, Monograph Series.) (Published for the Engineering Foundation.) Pp. xv+193. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*. net.

THE application of the phase rule to metallic systems sometimes presents difficulties, which, however, would be avoided if the principles laid down by Gibbs were strictly adhered to. A lax interpretation has become common, and it has been thought advisable to include, in a series of books devoted to the technical properties of the alloys of iron, an account of the principles on which phase diagrams are constructed and interpreted. The author has followed Gibbs throughout, and has kept to a strictly thermodynamical treatment, ignoring all questions of atomic arrangement.

The work has been done thoroughly, and the author is at pains to be logical, even at the cost of making some of the chapters rather hard reading for the metallurgist. It is only at the end of the book that any concrete examples are given, and then the ternary system selected, that of iron-carbon-silicon, is an unfortunate one, having been very inadequately studied in the laboratory. The terminology of much writing on metallic phase diagrams being rather loose, the author has suggested one on strictly logical principles. No objection can be taken to it on this ground, but the number of new terms is so large as to make it unlikely that it will be widely adopted. A simpler treatment would have been more helpful, but a careful study of this book will repay itself. In the modern study of alloys, however, changes which can only be accounted for by movements of atoms fall to be considered, such as the ordered-disordered changes in solid solutions and the precipitation of ultra-microscopic particles in age-hardening, and it would be of interest to discuss how far these can be represented in any system of phases.

Liquid Fuels:

their Manufacture, Properties, Utilisation and Analysis; a Practical Treatise for Engineers and Chemists. By Harold Moore. Pp. viii+264+4 plates. (London: The Technical Press, Ltd., 1935.) 21*s*. net.

THE book is put forward as a manual for chemists and engineers interested, but not specialists, in the subject of liquid fuels. Mineral oils, shale, tar oil, benzole, alcohol and vegetable oils and their manufacture are briefly described. Their behaviour, singly and admixed, in internal combustion engines is treated in considerable detail, both for engines with spark and compression ignition. Then follows the preparation and use of heavier oils for external combustion, including domestic heating and lighting. The value of the section on analysis and testing is increased by the author's comments on the significance of results of the various tests.

On the technology of coal products, the book is less precise. The author does not indicate the rapid growth of benzole production by gas works now in progress. Indeed, he seems to imply that the practice ceased after the War. On p. 49 he states that the horizontal gas retort tar is the "main source of benzene". Although the 'inhibitor' process is revolutionising the refining of benzole, it does not appear in the index. 'Gas oil' is an important fraction of petroleum, but no indication is given of the requirements of a good oil for carburetting water gas, and its use for this purpose would appear to be subsidiary to that of domestic fuel.

Leaving aside such criticisms, there must be many users and potential users of liquid fuels who need the information in this book, and to them it may be heartily commended.

H. J. H.

Forthcoming Books of Science

Agriculture and Horticulture

Chatto and Windus—A History of Gardening in Scotland, E. H. M. Cox.

Faber and Faber, Ltd.—The Land: Now and Tomorrow, Prof. R. G. Stapledon.

Macmillan and Co., Ltd.—Tropical Planting and Gardening, H. F. Macmillan.

Putnam and Co., Ltd.—Hardy Bulbs, Lieut.-Col. C. H. Grey.

Anthropology and Archæology

Jonathan Cape, Ltd.—The Source of Civilization, Gerald Heard; We Europeans, Prof. Julian S. Huxley, Dr. A. C. Haddon and Prof. A. M. Carr-Saunders; The Wilderness of Zin, C. L. Woolley and T. E. Lawrence.

Constable and Co., Ltd.—Sudsee, Dr. A. Bernatzik; Gari-Gari, Dr. A. Bernatzik.

Cresset Press, Ltd.—China: a Short Cultural History, G. P. Fitzgerald; Archaic Marble Sculpture from the Acropolis, H. Payne and G. M. Young; The Dream in Primitive Cultures, Dr. J. S. Lincoln.

Macmillan and Co., Ltd.—Prehistoric Man in Ireland, C. P. Martin.

Oxford University Press.—Human Ecology, Prof. J. W. Bews; Both Sides of Buka Passage, Beatrice Blackwood; Papuans of the Trans-Fly, F. E. Williams; The Aqueducts of Ancient Rome, T. Ashley, edited by I. A. Richmond; Bible and Spade, Dr. S. L. Caiger; Tomb Development, G. A. Reisner.

Biology

George Allen and Unwin, Ltd.—How Animals Develop, C. H. Waddington.

D. Appleton-Century Co., Inc.—Snake-Hunter's Holiday, Dr. R. L. Ditmars and W. Bridges.

Edward Arnold and Co.—The Oyster and the Oyster Fishery, Prof. J. H. Orton.

A. and C. Black, Ltd.—Garden Ponds and Aquaria, W. Cotton; The Wonderland of Common Things, Rosa E. Jones.

Cambridge University Press.—The Vitamins in Theory and Practice, L. J. Harris; Order and Life, Dr. Joseph Needham.

Cassell and Co., Ltd.—The Living Things Around Us, T. J. S. Rowland; Sea-Gulls in London, Seton Gordon.

Chatto and Windus.—A Diary of Thomas Henry Huxley, edited by Prof. Julian Huxley.

J. M. Dent and Sons, Ltd.—Birds, Beasts and Pond Life, Eric Fitch Daglish; Plants, Flowers and Insects, Eric Fitch Daglish.

George G. Harrap and Co., Ltd.—Over African Jungles, Martin Johnson; Vanishing Wilderness, F. R. La Monte and M. H. Welch; The Book of Animal Life, Thora Stowell; The Book of Zoography, Dr. R. L. Ditmars.

Hodder and Stoughton, Ltd.—Wild Life Ways, Harper Cory, Handbook of Botanical Diagrams, Dr. Blodwen Lloyd: Studies in Plant Life, Dr. E. M. Poulton.

Hutchinson and Co., Ltd.—Race, Sex and Environment, J. R. de la H. Marett; Practical Zoology, H. R. Hewer.

Longmans, Green and Co., Ltd.—Birds and the Sea, Frances Pitt; The Variation of Animals in Nature, G. C. Robson and O. W. Richards.

McGraw-Hill Publishing Co, Ltd.—Pollen Grains, R. P. Wodehouse.

Macmillan and Co., Ltd.—Intermediate Botany, L. J. F. Brimble; Introductory Biology, E. Stenhouse: Class-Book of Biology, E. Stenhouse.

Methuen and Co., Ltd.—A Textbook of Practical Botany, Dr. W. Leach.

John Murray.—Heredity and Evolution, A. E. Watkins.

Thomas Nelson and Sons, Ltd.—Grey Owl and the Beaver, Harper Cory.

Ivor Nicholson and Watson, Ltd.—Life on Shore and Shallow Sea, D. P. Wilson.

Oliver and Boyd, Ltd.—A Vertebrate Fauna of Forth, Leonora J. Rintoul and Evelyn V. Baxter.

Rich and Cowan, Ltd.—Tropical Fishes and Home Aquaria, A. Morgan.

George Routledge and Sons, Ltd.—Health and Human Progress, Dr. R. Sand.

University Tutorial Press, Ltd.—Textbook of Biology, E. R. Spratt and A. V. Spratt.

Ward, Lock and Co., Ltd.—Ward, Lock's Natural History, edited by Dr. C. Tate Regan.

Williams and Norgate, Ltd.—Succulent Plants, H. Jacobsen.

Chemistry

Chapman and Hall, Ltd.—Electrolytic Oxidation and Reduction, Dr. S. Glasstone and Dr. A. Hickling; The Chemistry of Milk, Dr. W. L. Davies; Fluorescence Analysis in Ultra Violet Light, J. A. Radley and Dr. Julius Grant.

Eyre and Spottiswoode, Ltd.—The Dictionary of Organic Compounds, vol. 2, edited by Prof. I. M. Heilbron.

Charles Griffin and Co., Ltd.—Text-Book of Inorganic Chemistry, vol. 11, part 3, and vol. 6, part 5, edited by Dr. J. Newton Friend.

Macmillan and Co., Ltd.—Chemistry for the Higher School Certificate Examination, Prof. T M. Lowry and A. C. Cavell.

Methuen and Co., Ltd.—Flame, O. C. de C. Ellis and Dr. W. A. Kirkby; The Quantum Theory of Valency, W. G. Penney; The Chemistry of Rubber, Prof. H. Freundlich.

George Routledge and Sons, Ltd.—Physical Aspects of Organic Chemistry, Dr. W. A. Waters.

Engineering

Philip Allan and Co., Ltd.—Gliding and Soaring, C. H. Latimer-Needham.

Cassell and Co., Ltd.—How, Why and When ?—Railway Engines, R. B. Way.

Chapman and Hall, Ltd.—Electrical Engineering in Radiology, L. G. H Sarsfield; Power Factor Indicator, D. J. Bolton; A Treatise on Screws and Worm-Gears, their Mills and Hobs, P. Cormac; High Speed Diesel Engine Maintenance, A. W. Judge.

Crosby Lockwood and Son, Ltd.—Alternating Current Practice, C. H. C. Cooke.

English Universities Press, Ltd.—Aerodynamics, N. A. V. Piercy; The Testing of Internal Combustion Engines, R. W. J. Pryer and S. J. Young; Elementary Principles of Automobile Engineering, J. R. Kinsey; The Transmission and Distribution of Electrical Energy, Prof. H. Cotton; The Electrification of Agriculture and Rural Industries, E. W. Golding; The Rectification of Alternating Current, H. Rissik; The Utilisation of Electrical Energy, E. Openshaw Taylor.

Charles Griffin and Co., Ltd.—Practical Boiler Firing, H. C. Armstrong and C. V. Lewis; Aero Engines, vol. 2, Design and Construction, J. D Frier.

McGraw-Hill Publishing Co., Ltd.—Relay Systems—Theory and Application, I. T. Monseth; Press Work Pressures, C. W. Lucas.

Ivor Nicholson and Watson, Ltd.—The Nation's Water Supply, R C. S. Walters.

Oxford University Press.—Elasticity, Prof. R. V. Southwell.

Sir Isaac Pitman and Sons, Ltd.—Seaplane Float and Hull Design, M. Langley; Practical Performance Prediction of Aircraft, Lt.-Col. J. D. Blyth; Practical Air Navigation, Wing-Commdr. J. K. Summers; Inter-

mediate Engineering Drawing, A. C. Parkinson; The Surface Condenser, B. W. Pendred; River Work Constructional Details, H C. H. Shenton and F. E. H. Shenton; Mercury Arc Current Convertors, H. Rissik.

Geography and Travel

Cassell and Co., Ltd.—Sledge, Martin Lindsay.

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Geology

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Mathematical and Physical Sciences

G. Bell and Sons, Ltd.—Electricity, Prof. W. L. Bragg.

Blackie and Son, Ltd.—Differential and Integral Calculus, vol. 2, R. Courant, translated by E. J. McShane; A Textbook of Physics, vol. 5, Physics of the Atom, E. Grimsehl, edited by R. Tomaschek, translated by Dr. L. A. Woodward; Atomic Physics, Dr. Max Born.

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Miscellany

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Cambridge University Press.—Collected Papers of Sir William Bate Hardy.

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Sheed and Ward.—The Spirit of Mediæval Philosophy, Etienne Gilson; Religions of Mankind, Otto Karrer.

Technology

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Crosby Lockwood and Son, Ltd.—Design Problems of Heating and Ventilating, A. T. Henly; Refrigeration: Industrial, Commercial, Domestic, B. Oldham; Drying and Drying Equipment, K. R. Robertson.

Fountain Press, Ltd.—Practical Infra-Red Photography, Dr. O. Helwich, translated by J. L. Baring; Enlarging and Enlargers of Today, W. Alexander.

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Sir Isaac Pitman and Sons, Ltd.—Wireless Telegraphy, W E. Crook.

George Routledge and Sons, Ltd.—Tools of Tomorrow, J. N. Leonard.

Technical Press, Ltd.—Technical Electricity for Junior Students, J. E. Phillips.

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Apparatewesen E.V., held at Königsberg on July 3–5 last, indicate that the object aimed at is the use of raw materials obtained in Germany in the manufacture of German goods. When a suitable material, native to that country, is not available, steps should be taken to enable other materials, found in Germany, to be adapted for the required purpose. Where, however, suitable substitutes cannot be found, investigations should be made with the view of constructing the plant or article using the minimum quantities of imported materials. No details regarding how these objects are to be attained are given, so that unless the original papers are studied, little more than an outline of the subjects considered can be obtained, the motto of the congress being "Nur deutsche Stoffe für deutsche Waren".

Engineers' Study Group on Economics

THE Engineers' Study Group on Economics is entering its third year of activity, and Sir Richard Gregory has been elected president for the year. The Group consists of six sections investigating the various factors that may help to solve the present paradox of poverty amidst plenty. An analysis of twenty-four existing or proposed social and economic systems, prepared by Section B of the Group, was noticed in NATURE of May 25, 1935, p. 884. Section A, which is investigating the available, the desirable and the potential production of Great Britain, hopes to present a similar report shortly. Scientific workers, not necessarily engineers, willing to help in the application of scientific principles to the urgent problems of the day are welcomed by the Group. The yearly subscription is: minimum 5*s*., maximum £1. Sections meet in the evening at 85 Gloucester Place, W.1. The next group meeting will be at the Guildhouse, Eccleston Square, S.W.1 (Berwick Street entrance), on Tuesday, October 15, at 7 p.m.; Sir Richard Paget will speak on his recent visit to the U.S.S.R. Those wishing to attend should notify the honorary secretary, A. H. Hayes, Hazlitt House, Southampton Buildings, W.C.2 (Tel.: Holborn 1068).

Tsetse Fly Control

THE report of the East Africa Sub-Committee of the Tsetse Fly Committee, Economic Advisory Council (Cmd. 4951. London: H.M. Stationery Office. 1*s*. net), epitomises many factors bearing upon the problems of human sleeping sickness, as well as of tsetse fly diseases of animals, in Africa. Both diseases are caused by trypanosome parasites and are transmitted by tsetse flies, so that methods for eradication of the flies constitute important preventive measures. The most recent advance in this direction is by means of densification of the vegetation. It has been found that if a patch of tsetse-infested bush is protected from grass fires for several seasons, the growth becomes so dense as to be highly unfavourable to certain species of tsetse, and further investigation on these lines on a large scale is desirable.

Therapeutic Substances

THE Joint Committee constituted under the Therapeutic Substances Act, 1925, has issued additional regulations dealing with several agents, namely, staphylococcus toxoid, antipneumococcus serums (Types i and ii), staphylococcus antitoxin, gas-gangrene antitoxins and diphtheria prophylactic ("Statutory Rules and Orders 1935, No. 580"). The provisions applicable to these substances, which have now attained definite value in medical practice, include definition and proper name, labelling, quality, strength, and tests of potency, and unit of standardisation.

Export of British Scientific Instruments to France

CERTAIN kinds of British optical and scientific instruments are subject to special quotas when imported into France. In order to ensure the full benefit of these quotas to British manufacturers, and to prevent the detention of shipments, the French Government has authorised the Scientific Instrument Manufacturers Association of Great Britain to issue certificates to shippers. The instruments to which these certificates apply are as follows:—simple surveying instruments; dividing machines; house barometers; apparatus for physical and chemical demonstration for schools and colleges; apparatus for physical and chemical researches and analyses; surveying instruments for geodesy, topography and measurements of angle. More precise information may be obtained from the Secretary, Scientific Instrument Manufacturers Association of Great Britain, Limited, 329 High Holborn, London, W.C.1.

International Exhibition of Nature Photography

THE Right Hon. the Earl of Onslow, president of the Society for the Preservation of the Fauna of the Empire, will open an International Exhibition of Nature Photography in the Whale Hall of the British Museum (Natural History), South Kensington, on Wednesday, October 16, at 12 noon. The object of the exhibition is to show the advance nature photography has made during recent years; and the exhibition should be of considerable interest and educational value. It will remain open every day from 10 a.m. until 6 p.m. (Sundays 2.30 p.m. until 6 p.m.) from October 16 to November 30. Admission is free. More than 1,200 photographs of birds and mammals will be shown, including examples from all British Colonies as well as from the United States, Poland, Japan, etc.

French Congress of Hygiene

THE twenty-second French Congress of Hygiene will be held at the Institut Pasteur, Paris, on October 21–23, when the chief subjects for discussion will be the hygiene and protection of infancy, and will be followed on October 23 by a meeting of the Société de la météorologie médicale, an offshoot of the Société de médecine publique. Further information can be obtained from the general secretary, Dr. Dujarric de la Rivière, Institut Pasteur, rue Dutot, Paris.

German Pharmacological Society

THE German Pharmacological Society will hold its annual meeting at Munich on October 20–23, when

the following subjects will be discussed: (1) water excretion of mammals and its physiological regulation, introduced by Verney of Cambridge; (2) the problem of the relation between chemical constitution and pharmacological therapeutic action, introduced by Schuleman of Elberfeld; (3) hynotics and basal narcosis, introduced by Weese of Elberfeld, Schön of Leipzig and Frey of Düsseldorf; (4) pharmacology and clinical employment of circulatory stimulants, introduced by Hildebrandt of Giessen and Killian of Freiburg. Further information can be obtained from Prof. Janssen, Pharmacologisches Institut, Freiburg i. B., or the general secretary, Prof. B. Behrens, Dorotheenstrasse 28, Berlin.

Announcements

THE RIGHT HON. J. RAMSAY MACDONALD will open the Coal Hydrogenation Petrol Plant of Imperial Chemical Industries, Ltd., at Billingham-on-Tees, Durham, on October 15.

AN *Exchange* telegram from Copenhagen states that Prof. Niels Bohr, on his fiftieth birthday on October 7, was handed 100,000 kroner (nearly £4,000), which has been subscribed for among scientific societies in Denmark for the purchase of radium for research.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. A. Pickles, to be entomologist, Department of Agriculture, Trinidad; Mr. J. W. Costello, late assistant conservator of forests, to be assistant conservator of forests, Nigeria; Mr. T. A. Strong, deputy conservator of forests, to be conservator of forests, Malaya; Mr. J. G. Watson, conservator of forests, to be deputy director of forests, Malaya.

A BIOCLIMATIC investigation department is to be established at Bad Pyrmont under the direction of Reg. Rat Lossnitzer, of Berlin.

AN institute for the biology of heredity and racial hygiene has been opened at Frankfurt-on-Main under the direction of Prof. Eugen Fischer.

THE King of the Belgians has recently laid the first stone of a cancer institute bearing the name of Jules Bordet, in honour of the former director of the Pasteur Institute of Brussels. The Institute is attached to the new Hôpital St. Pierre, Brussels.

A POWER Farming Conference will be held in Oxford in January next under the auspices of the School of Rural Economy, the Institute for Research in Agricultural Engineering, and the Agricultural Economics Research Institute. The date provisionally fixed for the Conference is January 7–10.

DURING the recent International Congress of the History of Medicine at Madrid, the degree of doctor *honoris causa* was conferred at the ancient University of Alcala en Henares among others on Sir Humphry Rolleston, the British delegate, and Profs. Neuburger of Vienna, Diepgen of Berlin, Laignel-Lavastine of Paris and Sigerist of Johns Hopkins, who occupy the chair of the history of medicine in their respective universities.

BY courtesy of the Compagnie Générale Transatlantique, the Science Museum, South Kensington, has secured the loan of a fine model, more than ten feet in length, of the *Normandie*, the present holder of the Blue Riband of the Atlantic. The *Normandie* has a length of 1,029 ft., beam 119 ft., tonnage 79,280, and turbo-electric machinery developing 160,000 horse-power. Her record-breaking run, New York to Plymouth, was accomplished in 4 days 3 hr. 25 min. at an average speed of 30·31 knots.

MESSRS. A. GALLENKAMP AND CO., LTD. (Technico House, Finsbury Square, London, E.C.2), have issued a revised edition of their catalogue "Apparatus for the Examination of Soil". The list includes the latest patterns and modifications of standard apparatus used in connexion with all types of soil work. Where desirable, directions for use are included, together with the appropriate bibliographical reference, so that direct contact with the scientific origin of the apparatus is possible.

ERRATUM.—In Prof. Karl Pearson's letter on "Statistical Tests" in NATURE of October 5, p. 550, the values of the eccentricities e should have been given in tenths, not hundredths; that is, $e = 0{\cdot}6$, not $0{\cdot}06$. This has no bearing on the argument.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A research assistant in insect physiology in the Imperial College of Science, South Kensington, S.W.7 (Oct. 15).

A lecturer in mechanical engineering in the Birmingham Central Technical College—The Principal (Oct. 19).

A chemist in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Oct. 25).

A junior assistant for the Directorate of Explosives Research—The Chief Superintendent, Research Department, Royal Arsenal, Woolwich, S.E.18 (Oct. 26).

A lecturer in mathematics in Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14 (Oct. 28).

A lecturer in physics in the University of Cape Town—The Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (Nov. 5).

A virus physiologist at Rothamsted Experimental Station, Harpenden, Herts—The Secretary (Dec. 15).

An assistant lecturer in agriculture in the Midland Agricultural College, Sutton Bonnington, Loughborough—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 609.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Robert Hooke and his Contemporaries

SOME among us, long interested in the life and times of distinguished scientific and literary personalities of the mid-seventeenth century, would fain retain the opinion that Henry Oldenburg was eminently fitted to occupy the special post that was assigned him; moreover, that his very detachment from the realms of experimental adventure and inventiveness actually facilitated and did not invalidate remarkable services, securing freedom, with a responsibility of high order.

Yet we find the reviewer of "The Diary of Robert Hooke" (NATURE, Sept. 7, p. 358) writing as follows: "I, for one, have the impression that he [Oldenburg] was an oblique, intriguing and toadying individual, jealous of Hooke's fame and earnings" (p. 360).

As a possible antidote to the implications of this conclusion, it is opportune to refer readers of NATURE to an article on Henry Oldenburg which appeared in this journal forty-two years ago (November 2, 1893), the author of which had an immediate and close intimacy with relevant documents, though not, it is true, with the lavender entries of an unpublished diary.

It may be found perhaps, on reference thereto, that the epithets "oblique" and "toadying" applied to Oldenburg cannot be sustained except at some sacrifice of historical propriety and appropriate justice.

The circumstance that no portrait of Hooke is extant is probably associated with his fickle physical condition. Certainly, he would have been a most difficult, wayward 'sitter'. We may, however, believe that Evelyn was sorry that Hooke did not occupy a place in that gallery of celebrities in which he himself was so interested. T. E. JAMES.

59, Sharp's Lane,
Ruislip.

IN his account of the extraordinarily intriguing, human and intimate part of the "Diary of Robert Hooke", published in NATURE of September 7, Prof. Andrade has suggested that the biographer, Richard Waller, "apparently had little personal knowledge of Hooke or his intimates". This may have been the case during the earlier period before 1680, but entries in the later Diaries, which I have recently transcribed and printed, show that Waller and Hooke were fellow members of a coffee-house coterie, that met almost daily at Jonathan's. It was the habit of Hooke to abbreviate the names of his friends, and many were the talks and walks in which Hooke mentions the companionship of "Lod", "Cur", or "Wall", either into the country or to attend book-auctions held in the vicinity. That no official portrait of Hooke was painted for the Royal Society, and that no obituary notice appeared of him in the *Philosophical Transactions*, may be ascribed to the fact that his death was immediately followed by the election of Newton to the presidential chair, and Newton is known to have been unfavourably inclined towards Hooke. The neglect was in part remedied when Waller printed the "Posthumous Works" of Robert Hooke in 1705.

R. T. GUNTHER.

The Old Ashmolean,
Oxford.
Sept. 17.

MR. JAMES's letter is of interest as recording that he personally does not agree with my opinion of the character and temperament of Oldenburg, but it has little objective content. In my article I referred briefly to some of the facts on which I base my conclusions: the affair of the watch, where Oldenburg, who had a (secret ?) financial interest in a rival invention, went out of his way to decry Hooke's achievements, and certainly went beyond what he would have known: the undoubted political, although no doubt innocent, correspondence with foreigners, which he denied: the opinion of Sydenham. I may further point out that in his correspondence with Spinoza, extending over the years 1661–76, in which the scientific discoveries of the day are freely discussed, and the names of Boyle and Huygens occur again and again, there is only one reference to Hooke's work (to the "Micrographia", without mention of Hooke's name).

As for the question of jealousy, I am by no means alone in my opinion. To quote but one authority, Prof. More in his recent "Isaac Newton" says, *à propos* of Oldenburg's mischief-making between Newton and Hooke, "The motive for the advice [to Newton] may have been a sincere interest in his friend's welfare, but it was undoubtedly influenced by the evident jealousy which existed between himself and Hooke. As a consequence of his own antipathy, he exaggerated the Curator's [Hooke's] irascibility and gave the impression that matters were worse than they actually were. This time he succeeded." Elsewhere Prof. More has occasion to animadvert on reprehensible activities of Oldenburg.

If Mr. James would show that the points to which I have briefly referred cannot support my view of Oldenburg's character, and would state that there is nothing in the letters to Boyle which can be called toadyism, it would be more to the point than a vague and somewhat offensive insinuation that I have sacrificed historical propriety, and it would then be worth while for me to adduce other support.

The reference to the old article in NATURE (November 2, 1893) is curious. This article was unknown to

me, but on the other hand I am very familiar with the article in the "Dictionary of National Biography", which is from the same hand—that of Mr. Herbert Rix. The latter article, which cites Oldenburg's "peculiar temper", and his draft petition for a patent for Huygens' watch, has contributed to form my unfavourable opinion of Oldenburg's character. It further points out that Oldenburg first enthusiastically urged Spinoza to publish his writings, and afterwards withdrew. I have now read the NATURE article, and do not find that it runs counter to my views. Rix calls Oldenburg "an interesting man who lived in a most interesting period", and opines that without his endeavours, and those of Hooke, the Society would scarcely have held together, with all of which Mr. James and I will both agree. So far as I can see, there is nothing that shows any particular sympathy with Oldenburg's personal character, and Mr. RIX's other article, which was published two years later, and must represent his considered opinion, seems to me definitely unfavourable.

Hooke's character was manifestly imperfect, but he had the excuses of genius and chronic illness, neither of which can be advanced for Oldenburg. I was concerned not so much to estimate Oldenburg, who was, after all, a very second-rate intellect ("His scientific observations were certainly very mixed, many of them trivial, and some of them superstitious," says Mr. Rix), but rather to point out that Hooke had just cause to complain of him. I agree with Prof. More, where he refers to Hooke "showing the contrast of an essentially noble character in large matters with an irritable, suspicious and cynical temperament in the familiar affairs of life", and I am of the opinion that Oldenburg did much to embitter Hooke's character and to bring into prominence his weaker points. If all that can be done to shake my views as to Oldenburg's character is to refer to an article which stresses his undoubted industry and vast correspondence, and to sneer at Hooke's private record as "lavender entries", I shall continue in my error.

So far as I know, the Diary which Dr. Gunther has transcribed had not been published when I wrote the article in question. This alone is sufficient to account for my not having read it. I may add that Waller himself says "the greater part of my Vouchers have been either taken out of his own Memorials or from the Journals of the Royal Society", and although it is clear from his biography of Hooke that he had spoken with his subject on more than one occasion, there is nothing in it that bespeaks intimacy.

As regards the general question of a portrait, although none has survived, it seems probable from the Diary which I reviewed that one was made, for on October 16, 1674, we read "Mr. Bonust drew picture", and on December 24 of the same year, "The workmen left work did nothing but get together my picture frame". The painter, of whom it is earlier recorded "Mr. Janeway sat for picture to Mr. Bonus", was, according to Mr. Robinson's editorial note, probably Bownest, who painted portraits, principally of dissenting ministers. Perhaps, then, there is a portrait somewhere in existence.

E. N. DA C. ANDRADE.

Physics Laboratory,
University College,
London, W.C.1.
Sept. 21.

The Meaning of Probability

I SUGGEST that Dr. Dingle's problem in his article in NATURE of September 14, p. 423, is not quite fairly stated. If Ohm's law has been found true in 9,999 cases and found false in one case, and if P who speaks truth once in 10,000 times says *he has found* it true, it is equally probable that he has struck the exceptional case and told the normal lie, or struck the normal case and told the exceptional truth. If this is not immediately clear, it becomes so on considering 10^8 experiments by P, assuming, as is proper, that the exceptional case occurs once in 10,000 times throughout. In this sense, the probability that P has found the law false is one half.

W. BARRETT.

Fuglestemmen,
Layters Way,
Gerrards Cross,
Bucks.
Sept. 16.

IN his article on 'The Meaning of Probability' in NATURE of September 14, Dr. Dingle has attempted to support his case by means of a striking example. Unfortunately his illustration is by no means happily chosen, and the issue may be further confused by his treatment of it in a way no one is likely to defend. When the truth (by which we do not mean the whole truth and nothing but the truth) of Ohm's law is in question, only evidence arising from experimental investigations is pertinent; no statement, independent of experimental work, by any individual, whatever his habit regarding the truth, is of value. On the data given, the probability that the law will be found to hold in a new experiment is therefore 9,999/10,000.

For the purpose of the discussion, Ohm's law must be replaced by a question in which individual testimony constitutes relevant evidence. If we then waive the debatable point of attaching any value whatever to the statement of so notoriously untruthful an individual, we cannot reach the probability $\frac{1}{2}$ put forward by Dr. Dingle. Each statement, like each experimental inquiry, has to be regarded as a separate item of evidence. In the absence of qualifying evidence, each is to be given equal weight. Dr. Dingle, on the other hand, invites us to regard the combined results of 10,000 experiments as no more than equal in weight to a single statement made by a confirmed liar. It is obvious that we exaggerate the effect of this statement on the probability if we replace it by an additional experiment unfavourable to the law. The probability, then, so far from falling from 9,999/10,000 to $\frac{1}{2}$, certainly does not fall as far as 9,999/10,001. The ratio which would result from the given figures by simple enumeration is, in a suitable problem, 9,999·0001/10,001.

It may be observed that the fractional part of the numerator would not become zero, even if the data were strengthened to the extent that the individual concerned had never been known to tell the truth.

T. SMITH.

National Physical Laboratory,
Teddington.
Sept. 17.

A SUFFICIENTLY general statement of the problem I was trying to exemplify is as follows:—*If we have two independent sources of information* (β *and* γ) *bearing on the question of the truth or falsehood of a proposition*

(α), *does a combination of* β *and* γ *make a significant contribution to the question?* My answer was, No; Dr. Sterne's was, Yes, because a combination could be found which would give a unique answer. I replied that uniqueness was not enough.

In the *A* and *D* problem and the Ohm's law problem, α, β and γ have the following meanings:—

	A and *D* Problem.	Ohm's Law Problem.
α	*D*'s remark is true	Ohm's law is true
β	*D*'s record	Experiment
γ	*A*'s weighted comment	*P*'s weighted comment

To me these two examples both come fairly within the general case. Mr. Barrett and Mr. Smith, however, appear to challenge this with regard to the second example. I will try to state their objections in terms of the general problem, and show why I believe them to be invalid.

Mr. Barrett's objection is, ultimately, that the two sources of information are not 'independent'. But that is only because he has arbitrarily assumed that *P*'s statement is based on one of the 10,000 experiments. *P*'s statement might have been groundless; he might have 'read about it in the papers' or, in fact, spoken on any ground whatever, *except* that which Mr. Barrett has assumed, for that makes his remark dependent on part of β.

Mr. Smith's objection is that γ is not 'information bearing on the question', because 'only evidence arising from experimental investigations is pertinent'. If he feels this, let him make the harmless supposition that *P* has performed an experiment in secret (outside the National Physical Laboratory, where the 10,000 experiments were made), and that his comment arises from this investigation. Mr. Smith's objection is then met. He will possibly retort that it is not met, because by 'experiment' he meant *experiment*, and not *P*'s report on experiment. If so, I would ask him whether he has personally verified every canonical fact in physics, or whether he has accepted some of those facts on hearsay. I think he must admit the latter alternative, not merely with regard to the statement of the results, but also with regard to the belief that those results were obtained by experiments, and were not invented. He can now dispense with the useless assumption that *P*'s statement is based on experiment, for since he cannot rule out a statement merely because it is hearsay, it makes no difference to his estimate of *P*'s statement, whether or not that statement includes an assertion that *P* has experimented.

I think, however, that what is at the *very* back of Mr. Smith's mind is that we must not allow the assertion of a convicted liar like *P* to affect our evaluation of statements of workers at the N.P.L. and other reputable institutions. In that I agree with him entirely: it is, in fact, just my argument against Dr. Sterne, who wishes to *combine* information from all sources, whereas I wish independent information to be kept independent.

I would summarise the attitudes of Mr. Smith, Dr. Sterne and myself (expressed, I think, rather than really intended, in the first case) to this question, as follows. Mr. Smith maintains that the two pieces of information are independent, but one of them is irrelevant, and he therefore rejects that one entirely. Dr. Sterne, while perhaps admitting that the pieces of information are independent, thinks that since they are both relevant, they can be combined into a unique, significant result. I hold that they are independent and both relevant, and therefore can yield two independent results the relative importance of which, of course, varies with the details of the problem.

If the foregoing analysis is valid, the last two-thirds of Mr. Smith's letter calls for no comment. I am puzzled, however, by his early casual remark that by truth "we do not mean the whole truth and nothing but the truth". I, at least, meant that. Perhaps he is merely asserting that, no matter how many experiments are performed, we do not necessarily *reach* the truth. That is so, of course, or we should not be talking about probabilities, but certainties. But I was assuming (without then or now committing myself to an opinion on this point, for fear of letting loose all the philosophers) what I imagined most readers of NATURE would agree about, namely, that the statement called 'Ohm's law' was true or false independently of our knowledge on the matter.

HERBERT DINGLE.

Imperial College,
London, S.W.7.
Sept. 20.

Negative Attenuation of Electromagnetic Waves and Sommerfeld's Theory of Ground Absorption

WE have recently measured the attenuation of wireless waves of 160 m. wave-length from a low-power Hartley transmitter installed in our laboratory. Measurements of electric field-strengths for various distances in two definite directions up to a distance of 4,800 m. have been carried out and the results are shown in Fig. 1. The attenuation factor A has been taken as the ratio $E.d./E_0.d_0$, where E_0 is the value of the field-strength at a distance d_0, which is so near the transmitter that there is no perceptible ground absorption and E is the value of the field-strength at any longer distance d. This ratio has been plotted as a function of the distance.

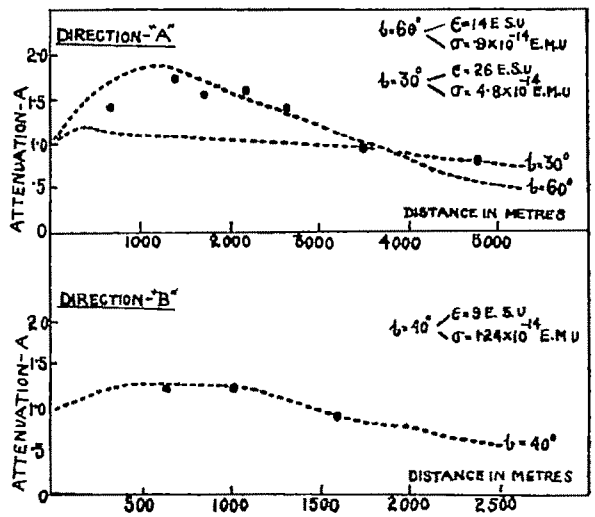

FIG. 1. Relation of attenuation factor to distance from transmitter. Observations, . . . ; theoretical curves, - - -

The results clearly indicate a negative attenuation of the wireless waves. In direction A, the attenuation at first rises to a value as high as 1·7 and then it gradually decreases and attains the value of unity at a distance of about 3,200 m. from the transmitter. The attenuation then falls below unity and gradually diminishes with distance in the usual way. In direction B, the attenuation rises at first to a value

of about 1·3, and then gradually falls and attains the value of unity at a distance of about 1,440 m. Beyond this, the value becomes less than unity and decreases gradually with the distance.

The negative attenuation, as has been pointed out by Ratcliffe and White[1], is to be expected under certain conditions from Sommerfeld's[2] theory of attenuation. According to Rolf[3], Sommerfeld's expression for attenuation can be represented in terms of only two quantities q and b when the field on the surface of the earth is considered. The quantities involve the electrical conductivity σ, the dielectric constant ε of the earth, the wave-length λ of the wireless wave, and the distance d from the transmitter.

Rolf has shown

$$\tan b = \frac{\varepsilon + 1}{6\lambda\sigma} \cdot 10^{-15} \text{ and } q = \frac{2\pi \sin b}{(\varepsilon + 1)\lambda} \cdot d$$

where distances are expressed in kilometres, ε in E.S.U. and σ in E.M.U. The attenuation curves drawn by Rolf show that for certain values of b there is negative attenuation.

Making use of Rolf's graphs and Sommerfeld's formula in the form given by Rolf and comparing the theoretical values of attenuation with our observed values, we have been able to determine the values of b, ε and σ in the two directions for $\lambda = 160$ m. In direction A, we find that, up to about 3,500 m., there is agreement between theory and experiment for $b = 60°$, $\varepsilon = 14$ E.S.U. and $\sigma = 0 \cdot 9 \times 10^{-14}$ E.M.U. Beyond this, in the same direction towards the river side we require, $b = 30°$, $\varepsilon = 26$ E.S.U. and $\sigma = 4 \cdot 8 \times 10^{-14}$ E.M.U. for good agreement with Sommerfeld's theory. From the comparatively larger moisture-content of the soil, the lower value of b and the higher values of ε and σ are to be expected in this region. For direction B we have to put $b = 40°$, $\varepsilon = 9$ E.S.U. and $\sigma = 1 \cdot 24 \times 10^{-14}$ E.M.U. to suit Sommerfeld's theory. The theoretical curves are shown in Fig. 1 along with the experimental values of the attenuation. The observed value of attenuation at distance $d = 710$ m. in direction A is a little too low. This is attributed to the slight screening action of a brick wall.

The values of ε and σ obtained from the attenuation measurements for $\lambda = 160$ m. agree well with the values obtained by us for the different specimens of Dacca soil by the direct laboratory method.

It should be mentioned that the negative attenuation was first observed by Ratcliffe and Barnett[4] employing wireless waves of 1,600 m. wave-length from the Daventry Station of the B.B.C. Ratcliffe and Shaw[5] also observed the same thing with a shorter wave-length (30 m.).

Very recently, Norton[6] has pointed out an error in Rolf's calculations. Some calculations which we have made lead us to suppose that this error does not materially alter the attenuation curves given by Rolf, at least for *very short distances* from the transmitter.

S. R. KHASTGIR.
D. N. CHANDHURI.
B. SEN GUPTA.

Physics Laboratory,
Dacca University.
Aug. 19.

[1] Ratcliffe and White, NATURE, 125, 926; 1930.
[2] Sommerfeld, *Ann. Phys.*, 4, 28, 665; 1909.
[3] Rolf, *Proc. I.R.E.*, 18, No. 3, March 1930.
[4] Ratcliffe and Barnett, *Proc. Camb. Phil. Soc.*, 23, 288.
[5] Ratcliffe and Shaw, NATURE, 124, 617; 1929.
[6] Norton, NATURE, 135, 955; 1935.

Dissociation Energy of Carbon Monoxide and the Heat of Sublimation of Carbon

IN two letters, published in NATURE of June 29, P. Goldfinger, W. Lasareff and B. Rosen have calculated the heat of dissociation of carbon monoxide and afterwards the heat of sublimation of carbon. They obtain their figures from the predissociations of the term $B^1\Sigma$ and the number of observed vibrational levels of the term $A^1\Pi$ of CO. There is, however, still another possibility of determining $D_{(CO)}$ originally suggested by Kaplan[1]. Of each of the two electronic states $b^3\Sigma$ and b', only one vibrational level is known, and this leads to the assumption of a repulsive curve, intersecting the potential curves of these two levels at 10·6 v.e. This value is well between the lower and upper limits (10·4 and 11·07 v.e. respectively) calculated by Goldfinger and Lasareff, but slightly below their final estimated value of 11·0 ± 0·1 v.e.

The repulsive curve which intersects at 10·6 v.e. is then the *lowest* one of all those which involve the level $C(^3P) + O(^3P)$ of the separated system, and in an earlier publication[2] we have, therefore, taken the slightly lower value of 10·45 v.e. as that of $D_{(CO)}$ which leads to a value of 155·7 kcal./mol. for the heat of sublimation of carbon (β-graphite) at 25° C.

The value of 10·45 v.e. for $D_{(CO)}$ may be confirmed in the following way. The level $B^1\Sigma$ lies at 10·72 v.e.; linear extrapolation yields a value of its energy of dissociation of 2·94 v.e., which is not necessarily correct, but is certainly an upper limit of it. This value is based on the value of the enharmonic constant of 50 cm.$^{-1}$, which is not certain; it appears that this value is the lower limit for the enharmonic constant, the other possible value being 76 cm.$^{-1}$. Since this level cannot be correlated to the level $C(^3P) + O(^3P)$, and since it certainly involves a level of the separated system with equal multiplicity of the two atoms, it has to be correlated to the level $C(^1D) + O(^1D)$. The two energies of excitation of C and O are together 3·21 v.e., giving an upper limit of $D_{(CO)}$ of $10 \cdot 72 + 2 \cdot 94 - 3 \cdot 21 = 10 \cdot 45$ v.e.

H. LESSHEIM.
R. SAMUEL.

Muslim University,
Aligarh.

[1] J. Kaplan, *Phys. Rev.*, 37, 1406; 1931.
[2] H. Lessheim and R. Samuel, *Proc. Phys. Soc. Lond.*, 46, 523; 1934.

Oxygen in the Sun's Chromosphere

PHOTOGRAPHS which I have taken at the Kodaikanal Observatory show that oxygen is a normal constituent of the sun's chromosphere, and is probably in great abundance.

Placing the slit of a spectrograph tangentially to the image of the sun's limb, I have found that the infra-red triplet of oxygen, λλ 7771, 7774 and 7775, shows as emission lines in the sun's chromosphere. This is not a unique appearance in one photograph only, for the reversal of the oxygen triplet into bright lines has been photographed every day since it was first observed.

Fig. 1 is a microphotometric record of one of my photographs taken on August 23, and clearly shows the oxygen lines as emission lines brighter than the continuous spectrum from the sky, compared with the neighbouring Fe and Ni absorption lines in the sky spectrum. When the chromosphere is not on

the slit, the sky spectrum, of course, shows the oxygen lines as absorption lines.

From the length of the emission lines as seen in my photographs with a straight slit tangential to the sun's limb, the greatest height reached by oxygen in the chromosphere is deduced to be 3·5″; but since the limb of the sun is probably a little distance from the slit at its nearest point (in order to avoid the risk of photospheric light entering the spectrograph) this is very likely an underestimate. In eclipse photographs, it is to be expected that the oxygen lines will extend to greater heights than this.

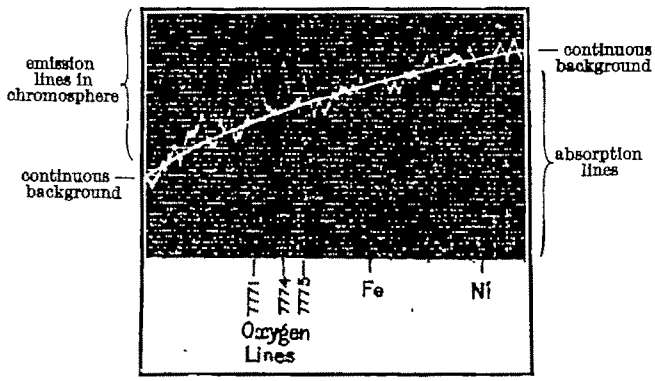

FIG. 1.

The presence of oxygen in the chromosphere, in addition to the previously known presence of H, He and Ca^+, is of importance for the theory of support of the chromosphere. This question is more fully discussed, together with details of the observations, in *Kodaikanal Observatory Bulletin* No. 107 which will appear shortly.

T. ROYDS.

Kodaikanal Observatory,
South India.
Aug. 29.

Records of Fatalities from Falling Meteorites

WITH reference to the remark in NATURE of July 27, p. 128, in a notice of Prof. Heide's "Kleine Meteoritenkunde" that "it is reassuring to find that there is no certain evidence of any person having been killed by a falling meteorite", may I direct attention to the following:

(1) Humboldt in his "Cosmos", vol. 1 (English translation by E. C. Otté. London, Bohn, 1849, p. 124), writes: "Several persons had been struck dead by stones falling from heaven, as for instance, a monk at Crema on September 4, 1511; another monk at Milan in 1650 and two Swedish sailors on board-ship in 1674".

(2) T. L. Phipson, in his "Meteors, Aerolites and Falling Stars" (p. 85) (London: Lovell Reeve, 1867), also mentions these incidents and describes particularly the Crema incident at great length, as the result of a meteoric shower, citing "The Commentary" of Surius, a Carthusian monk of Cologne, "De Rerum Varietate" of Jerome Cardan, and "Opus Epistolarum" of Petrus Martyr; and adds that "birds, sheep and even some fish were killed by the shower".

Prof. H. H. Nininger, secretary of the Society for Research on Meteorites, in his book "Our Stone-pelted Planet" (The Riverside Press, Cambridge, U.S.A., 1933), chapter xvii, "Danger from Falling Meteorites", refers to a man being wounded by the fall of a meteorite at Mhow, U.P., India, on February 16, 1827, and to another being stunned by the concussion from a meteorite which fell at Nedagolla, Madras, on January 23, 1870. The cases cited by Humboldt are not mentioned in this book, possibly because no specimens from these falls are preserved or are identifiable at present.

Ward's Bulletin (vol. 3, Nos. 1 and 2, October and December 1934, Rochester, U.S.A.) invited correspondence on the subject of 'homicidal' and 'man-killing' meteorites, but the accounts of alleged recent incidents received from correspondents either did not stand the test of accurate inquiry or were much too vague to call for an investigation.

There are several accounts of narrow escapes, some of which are mentioned in Nininger's book above referred to. I may mention one from the shower of September 29, 1928, near Naoki, Hyderabad, Deccan, described in the *Journal of the Osmania University College, Hyderabad*, vol. 1, No. 2; 1934, in which an aerolite is reported to have fallen "only twelve paces" from a shepherd at Kawagam.

MOHD. A. R. KHAN.

Begumpet, Deccan,
N.S.R., India.
Aug. 29.

MOST of the cases referred to in the above letter are mentioned in Prof. Heide's book along with several others; unless the two Indian cases quoted by Mr. Khan are better substantiated than the others I must prefer to accept Prof. Heide's statement that "noch kein einziger, sicher beglaubigter Fall ist vorgekommen, dass ein Mensch von einem Meteoriten erschlagen oder verletzt worden ist".

THE WRITER OF THE REVIEW.

Social Science Investigation

CERTAIN difficulties with regard to investigation in the social sciences are discussed in the leading article in NATURE of September 14. May I point out that perhaps these are not so great as at first sight appears?

In the first place, the difficulty of social experiments is largely overcome by legislation. An Act of Parliament concerning some social problem is in the nature of an experiment in dealing with it: it is the application of forces derived from the State designed to act on a particular part of society in certain ways more or less defined according to the terms of the Act. A certain amount of control also is not altogether lacking. Knowledge is obtainable as to the condition of the part of society affected before the operation of the Act, and it is obtainable also during and after its operation over any desired period; while the changes which are thus disclosed may frequently be connected with the Act in the relationship of cause and effect. Further information, too, is to be had in many cases where legislation on similar lines has taken place in our own past history, or in the history of other countries, and something may be learned regarding the effects produced in such cases.

We may take it as tolerably certain, however, that the changes effected in society by an Act of

Parliament are seldom confined to that part which it was designed to affect: it is bound to have its repercussions for good or for harm in all parts of society. It would be in tracing these ulterior effects where the skill of the investigator would perhaps be most taxed, since they call for knowledge of, and insight into, social structures and functions which few seem to possess.

I may add that Herbert Spencer's "Descriptive Sociology" (recently completed, I believe) is a work designed to supply the sociologist with facts concerning societies at large which should be useful in formulating the first principles of the science.

ALAN BLAIR.

Meir, Stoke-on-Trent.
Sept. 23.

Function of the Labral Glands in *Chirocephalus*

THE possible connexion of the labral glands with the feeding process in *Chirocephalus* has aroused considerable controversy (see Cannon[1]). Current work on the function of the numerous body glands in this animal leads us to the conclusion that these have the same function as the tegumental glands of the Decapoda (Yonge[2]), that is, the formation of the outer, cuticular portion, of the integument. The labral glands have essentially the same structure as the body glands and we have increasing evidence that they have the same function. We are therefore interested in the claim recently made by Cannon[1] that he has identified the secretion of the labral glands. He has directed attention to the presence in sections of an amorphous mass on either side of the labrum, over the ventral food groove and also throughout the gut, which stains with anilin blue. A very detailed study of the arrangement of this has led him to the conclusion that this must all be formed by the labral glands.

We find a number of *a priori* reasons for opposing this.

(1) The very great amount of this staining mass compared with the very small size of the glands, added to the fact that it must be poured out continuously because it is passed into the gut which, apart from the food, it fills.

(2) The difficulty of reconciling the presence of the mass outside, which Cannon claims is semi-coagulated, with the rapid movement of the appendages.

(3) The fact that multicellular glands present in the labral region in all 'Malacostraca' are certainly tegumental glands producing cuticle the presence of which is equally vital to all Crustacea.

(4) Where there is definite evidence as to the nature of the secretion of the unicellular dermal glands of the 'Entomostraca', for example, cement glands of Cirripedes, uterine glands of *Chirocephalus* (Yonge[3]), this is of the same nature as the secretion of the multicellular glands of the 'Malacostraca', for example, tegumental glands of *Homarus* (Yonge[2]), cement glands of *Homarus* (Yonge[3]), glands in statocyst of *Homarus* (Lang and Yonge[4]); nest-forming glands of *Amphithoe* (unpublished work), namely a substance of low surface tension which sets as a *hard cement* on contact with water. All the unicellular glands of the 'Entomostraca', including the labral glands, have essentially the same structure.

We have an alternative explanation as to the origin of the mass described by Cannon. This was suggested by the fact that antiperistalsis is of normal occurrence in the Crustacea. A *Chirocephalus* was kept overnight in a suspension of carmine. The gut was then red throughout and the animal was transferred to several changes of fresh water until no trace of carmine remained outside the body. It was then fixed in Bouin and observed at the same time under the binocular microscope. A series of antiperistaltic waves of contraction passed along the gut and about half the contents of the gut were regurgitated passing out of the mouth as a semi-coagulated mass which flowed forward on either side of the labrum and backward down the ventral food groove. The final appearance is indicated in Fig. 1.

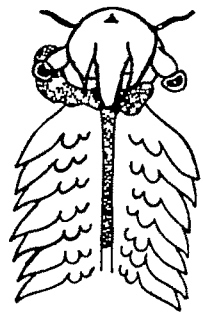

FIG. 1. Ventral view of the anterior portion of *Chirocephalus* after feeding with carmine and fixation. Regurgitated mass stippled.

Examination of sections of this animal revealed no essential difference between the distribution of this regurgitated mass and of the material described by Cannon and shown in the plate which illustrates his paper. The larger particles of carmine were the last to be extruded and occupied the position of the food, as described by Cannon, the other material, coagulated gut secretion with minute particles of carmine which gave it colour in the mass, spreading out forward on either side of the labrum and also in and below the food groove posteriorly.

We feel justified in claiming that the association of the labral glands with feeding has not been conclusively demonstrated. Prof. Cannon, with whom one of us (C.M.Y.) has had a very pleasant correspondence on this matter, is not entirely convinced by our arguments or experiments. One reason for publishing this letter is the hope that it may induce some third party, not previously committed to a belief in the secretion of the labral glands as either concerned with feeding or with the formation of the cuticle, to undertake a further study of the origin of this amorphous mass.

K. W. NICHOLSON.
C. M. YONGE.

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Bristol.

[1] Cannon, *Proc. Roy. Soc.*, B, **117**, 455; 1935.
[2] Yonge, *Proc. Roy. Soc.*, B, **111**, 298; 1932.
[3] Yonge, NATURE, **136**, 67; 1935.
[4] Lang and Yonge, *J. Mar. Biol. Assoc.*, **20**, 333; 1935.

Multiplanar Cyclohexane Rings

WITH reference to the letter of Dr. Qudrat-i-Khuda in NATURE of August 24, we wish to state that in this laboratory, the synthesis of the 1-carboxy-4-methyl-*cyclo*hexane-1-acetic acids from the dicyano ester prepared from 4-methyl*cyclo*hexanone by Higson and Thorpe's method, led only to a pair of isomerides melting at 137° and 173° respectively. These acids proved identical with the acids previously obtained by oxidation of the isomeric α-keto-4-methyl*cyclo*hexane-1:1-diacetic acids with hydrogen peroxide.

Since the remaining two isomerides described by Dr. Qudrat-i-Khuda were at no time encountered in

this synthesis, it was decided to repeat this work. The acids described as (*A*), (*B*) and (*C*) were isolated in accordance with this author's directions[1], but no trace of the fourth isomer could be obtained. The acids (*A*) and (*C*) proved identical with the two acids obtained by Higson and Thorpe's method, but the third isomer (*B*) was actually a mixture of (*A*) and (*C*). We thus arrived independently at the conclusion of Goldschmidt and Grafinger, that there are only two stereoisomeric forms of 1-carboxy-4-methyl*cyclo*hexane-1-acetic acid.

It may be added that we have been unable to isolate the carboxy-3:3-dimethyl*cyclo*hexane-1-acetic acid obtained from 3:3-dimethyl*cyclo*hexanone, in more than one form.

R. D. DESAI.
R. F. HUNTER.

Department of Chemistry,
Muslim University,
Aligarh.
Sept. 20.

[1] *J. Indian Chem. Soc.*, 8, 277; 1931.

Spectrum Analysis

THE term 'spectrum analysis' was originally used to denote the analysis of substances by means of their spectra, and it would probably still be interpreted in this sense by most experimental spectroscopists. To those not accustomed to this usage, however, it seems to connote the analysis of the structure of a spectrum, for example, its resolution into series or multiplets.

Might it not be well to abandon the term 'spectrum analysis' and substitute one free from this ambiguity?

Prof. E. N. da C. Andrade suggests 'spectrochemical analysis' and Prof. W. E. Curtis 'spectroscopic analysis'. For the time being, those associated with me here will endeavour to use the former phrase, but I should be glad, as doubtless would others, if through the medium of your pages other opinions could be brought to light for our guidance.

F. TWYMAN.

Adam Hilger, Ltd.,
98 Kings Road,
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London, N.W.1.
Sept. 19.

Points from Foregoing Letters

THE reviewer of "The Diary of Robert Hooke" is criticised by Mr. T. E. James for his description of Henry Oldenburg as an "oblique, intriguing and toadying individual". Mr. James ascribes the absence of Hooke's portrait in the Royal Society to Hooke's "fickle physical condition" probably making him a difficult 'sitter'. Dr. R. T. Gunther complains of the statement that the biographer, Richard Waller, "apparently had little personal knowledge of Hooke", and points to the recently published later diaries, which indicate that Waller was frequently in the company of Hooke. The reviewer, Prof. E. N. da C. Andrade, gives some of the historical evidence upon which he has based his unfavourable opinion of Oldenburg and asks for counter-evidence. He directs attention to diary entries which suggest that a painting of Hooke by "Bonust" may perhaps be in existence.

Dr. Dingle has distinguished three aspects of probability: (i) the ordinary everyday aspect or 'likelihood' (such as the odds in betting on a horse race), usually the result of instinctive evaluation rather than of calculation; (ii) the physicist's probability, measured from past events (the favourite wins once in ten times); (iii) the mathematically derived 'chance' of future occurrences derived by combining data from independent sources such as (i) and (ii). Dr. Dingle has called the probability calculated in this way a symbolical function, meaningless from the operational point of view. W. Barrett and T. Smith take exception to the reasoning in one example adduced by Dr. Dingle to illustrate his view. Dr. Dingle restates his case in general terms and points out that the objections raised are due to misunderstandings.

Graphs indicating first a rise and then a decrease in the attenuation of radio waves in two definite directions up to a distance of 4,800 m. are submitted by Dr. S. R. Khastgir, D. N. Chandhuri and B. Sen Gupta. The authors point out that the experimental results can be accurately accommodated by Sommerfeld's formula, making use of Rolf's graphs, by giving to the two main constants values agreeing with laboratory determinations of the dielectric constants and electrical conductivities of soils of varying moisture content.

From spectroscopic and quantum-mechanical considerations, H. Lessheim and Prof. R. Samuel calculate the heat of dissociation of carbon monoxide (by Kaplan's method) and find a somewhat lower value, 10·45 v.e., than that recently calculated by Goldfinger, Lasareff and Rosen in a different manner. The corresponding heat of sublimation of carbon comes to 155·7 k.cal./mol. at 25° C.

The presence of oxygen in the sun's chromosphere up to a height of 3·5″ or more has been observed by T. Royds by means of a spectrograph. The infra-red oxygen spectrum lines, 7771, 7774, 7775, are clearly recorded.

Referring to a recent leading article in NATURE, in which the various factors needed for the development of a social science were discussed, Alan Blair points out that Acts of Parliament are equivalent to social experiments; although perfect 'controls' to such experiments are lacking, one may compare the effects produced with conditions before the passage of such Acts and with the effect of similar laws elsewhere.

Prof. Cannon, by staining with anilin blue a specimen of the fairy-shrimp, *Chirocephalus*, has observed an amorphous mass on either side of the upper border covering the mouth (labrum) over the ventral food groove, and has concluded that it was secreted by the labral glands. Miss K. W. Nicholson and Prof. C. M. Yonge, who believe that the labral glands have nothing to do with feeding but are effective in the formation of the cuticle, report an experiment in which a *Chirocephalus* was fed a suspension of carmine. After fixation, an amorphous mass similar to that observed by Cannon but due merely to the regurgitated contents of the gut was noted.

Research Items

Early Man in Palestine

EARLY man in Palestine was the subject of a report and of communications from Miss D. A. E. Garrod, Sir Arthur Keith and Mr. T. D. McCown in Section H (Anthropology) at the Norwich meeting of the British Association. Miss Garrod's excavations in caves on Mt. Carmel on behalf of the Association's committee in 1934 carried further the excavation of Tabun ("The Oven") with the object of exposing bed-rock over as large an area as possible. Further finds of animal bones now give a very good idea of the fauna of the Acheuleo-Mousterian period. Both rhinoceros and hippopotamus confirm previous indications of a warm, damp period. A new and important find was a large portion of the tusk of an elephant, the first Pleistocene elephant to be discovered in the Near East. In the artefacts the typological divisions noted in the previous year were much less marked. A steep slope of the rock and its overlying deposits complicated excavation. It became clear that this slope ended in a swallow-hole, into which the deposits had subsided. As complete excavation of the swallow-hole would be costly and lengthy, further examination was abandoned, and the excavation of the Tabun may now be regarded as complete. In the report on the remains of Mousterian man in Palestine, Miss Garrod, dealing with the culture of the people of the caves of Wady Mughara, concluded that the association of skeletal remains with implements of Levallois type and the fauna of a warm, moist climate, as contrasted with the temperate woodland fauna of later Mousterian levels, indicated that they belonged to the end of the Riss-Würm interglacial, approximately contemporary with the Ehringsdorf and Tauback remains. Sir Arthur Keith and Mr. McCown dealing with the skeletal material, both complete and fragmentary, concluded that their anatomy pointed to a variant form of Neanderthal man, which exhibits features comparable with those of the more primitive races of modern man.

Psychology of Attention

THE *Human Factor* (9, Nos. 7 and 8) has an article by Mr. Ivor Benson on attention problems in the judging of newspaper literary competitions. The author describes the work of the adjudicators, and points to it as an open field of research for industrial psychologists. It offers what is perhaps a unique opportunity for studying the problem of attention among intelligent, imaginative workers. The circumstances of adjudicating necessitate the close control of material and output which is essential to psychological investigation, but can seldom be imposed upon workers of this kind. In performing a given task, the greatest possible sensitiveness, speed and accuracy must be maintained by the adjudicator at a constant level for as long as 7½ hours. The degree of efficiency varies from day to day, both collectively and among the individual workers. In the office tested, it was found that the root cause of inefficiency was emotional disturbance. Sensory distractions were unnoticed so long as the adjudicators were in a cheerful mood, but when they were gloomy they exaggerated sounds and movements and were disturbed by them. Fear and the sense of insecurity that followed a reprimand had also an inhibiting effect, and caused them to slacken their speed in over-anxious concentration.

Sperms of Freshwater Ostracods

THE remarkable spermatozoa of certain small freshwater ostracods are known to attain a length of 6 mm., that is, ten times the length of the adult ostracod. A. G. Lowndes (*Proc. Zool. Soc.*, London, Part 1, 1935) records the results of his observations on the spermatozoa of certain British ostracods with particular reference to their motility. He points out that motile sperms can be obtained only from the spermatheca of a female specimen, and that comparatively few females ever contain sperms, because parthenogenetic reproduction is prevalent. All attempts to obtain motile sperms from males were unsuccessful. Each sperm consists of a long thin pointed part which the author has observed to be anterior in movement, and a thicker cylindrical portion—the flagellum; Retzius and other previous observers regarded the thicker portion as anterior. Mr. Lowndes states that ripe eggs placed in a drop of fluid containing sperms are not attractive to the sperms; the entry of the sperm into the egg has never been described in ostracods. The thin anterior part of the sperm appears as a long central rod with a thin hyaline band twisted round it, and at its tip a small rounded knob, suggesting an acrosome. The flagellum has the appearance of a twisted cable, as there are two spiral bands. Throughout the entire length of the sperm is a central spiral thread, which in the flagellum is twisted round an axial strand. The sperm is enveloped in a thin hyaline membrane. Definite information as to the nature of the nucleus is lacking. Three kinds of movement of the sperm are described—rotation, undulation and ripple movement. The author points out that in many species of ostracods males are unknown, but the spermathecal ducts are present in the females, and there is no evidence that they are undergoing reduction. He regards the highly complicated copulatory apparatus and the abnormal sperms as having ceased to have any real function.

Watermark Disease of the Cricket-Bat Willow

DR. W. J. DOWSON described a serious disease of *Salix cærulea*, the cricket-bat willow, to the members of Section K (Botany) at the Norwich meeting of the British Association. The malady causes death of the tops, induces a greyish stain or watermark in the wood, and in all is responsible for a loss of something like £150,000 to the growers in Essex. Mr. Day, of Oxford, originally named the causal organism *Bacterium salicis*, but Miss Lindeijer, working in Holland, obtained a slightly different pathogen, which she named *Pseudomonas saliciperda*. Dr. Dowson now confirms Day's naming, so far as the disease in Essex is concerned, though a harmless organism with all the characters of *P. saliciperda* has also been found. Control measures suggested were mainly concerned with the extension of legislation to prevent spread of the disease.

Dating of Scottish Varved Clays

MEASUREMENTS made by Dr. J. B. Simpson of fifty-nine varves in a deposit near Dunning in the Earn valley south-west of Perth form the basis of an attempt by Baron De Geer to fix their absolute age (*Proc. Roy. Soc. Edin.*, **55**, 23; 1935). After a systematic comparison, De Geer has succeeded in matching the thickness-variation diagram of the varves with that of a series from the neighbourhood of Copenhagen. This indicates that the Dunning varves represent the years 4313–4371 before the zero year of the Ice Age, which itself occurred about 8,700 years before our century. Thus the measured varves were deposited during the earlier part of the Goti-glacial sub-epoch when the Scandinavian land-ice still filled the whole of the Baltic depression. That the varved clays near Perth are often moraine-covered may be explained by oscillations of the ice-border during its recession. Further measurements are necessary to determine whether varve-deposition was going on during the extension or the recession of the ice-border.

Natural Gas Conservation

THE trend of chemical research to-day indicates that, quite apart from its particular and well-known function in the production of oil, there is a wide field of usefulness for natural gas as a basic raw material in the manufacture of dyestuffs, solvents, anæsthetics, etc. Its conservation, therefore, is of paramount importance. Gas found in intimate association with commercial accumulations of oil has for some time past been conserved, so far as economically practicable, and a wealth of literature has emanated on this aspect of the subject. Mr. C. T. Barber, in his work on "The Natural Gas Resources of Burma" (*Mem. Geol. Surv. India*, **66**, part 1, 1935), takes a less familiar point of view, and stresses the importance of conservation of gas not found in association with oil. Of the vast natural gas resources of Burma, he points out, a considerable proportion is not in intimate association with commercial accumulations of oil. Some of this actually occurs in structures not containing, or not known to contain, oil, while some is found either as free gas in the crestal portions of oil-bearing sands or in non-oil-bearing beds in structures yielding oil from other horizons. In addition to problems of gas conservation, Mr. Barber's work includes a brief outline of the Tertiary geology of Burma, and detailed accounts of the principal natural gas fields, their geographical situation, stratigraphy, and approximate production. Useful maps and an up-to-date bibliography complete this latest work on natural gas in Burma.

Magnetic Testing of 'Work-Hardening' Steel Wires

THE testing of the steel wires used in colliery 'winding' and 'haulage' is of great importance. It is well known that the so-called 'work-hardening' of a wire rope is as great a menace to its safety as the actual mechanical fracture of a group of the component wires of a rope. In a paper which appeared in the *Engineer* of September 13, Dr. T. F. Wall, of the University of Sheffield, points out that only to measure the elasticity of the wires is not a sufficient criterion of their condition. Another characteristic quantity of the greatest importance is the viscosity of the metal forming the wires. There appears to be two kinds of viscosity, one associated with simple longitudinal stresses and the other type associated with a travelling surge of stress in the wire. Dr. Wall describes two electromagnetic methods. The first uses the magneto-striction effect for measuring Young's modulus for a wire by means of longitudinal vibrations. The other is to measure directly the speed at which a surge of stress travels along the wire. Experiments show that the former method provides a very sensitive means for detecting small effects of magnetic loading which cannot be detected in any other way. Work-hardening results in a relatively greater magnetic response to small stresses and a relatively smaller magnetic response to large stresses. The second method measures the velocity of a surge stress by passing the wire through several solenoids connected in series and at the centre of each of which is a search coil connected with an oscillograph. Oscillograms are taken with different magnetising forces and the one which shows that the magnitude of the induced E.M.F. in the search coils varies logarithmically gives the rate of decay of the surge itself. Knowing the velocity of the surge, Young's modulus can be found.

Activity Coefficients from Electromotive Forces

THE electromotive force of a cell containing two solutions of a uni-univalent salt at different concentrations is given by the equation $E = -(2tRT/F)\log(a_1/a_2)$, where t is the transport number and a activity. When, as is usually the case, t is a function of concentration, this must be replaced by $E = -(2RT/F)\int t.d\log a$, the integration being over the range of concentrations used. This equation has been used to find transport numbers, but now that accurate values of the latter are known, it can, as A. S. Brown and D. A. MacInnes (*J. Amer. Chem. Soc.*, **57**, 1356; 1935) show, be used in the determination of activities. The potential is known to be very reproducible and independent of the method of formation of the liquid junction, and this has been further confirmed by measurements with sodium chloride solutions. The electrodes were of silver and silver chloride. If the activity is expressed as the product of concentration (c) and activity coefficient (f), the values of the latter can be very well represented by Hückel's equation: $\log f = -\alpha\sqrt{c}/(1+\beta\sqrt{c}) + Dc$, where α, β and D are constants. It was, however, necessary to change the theoretical value of β from 1·463, as obtained by extrapolation at high dilutions, to 1·315. The value 1·463 corresponds with a 'distance of closest approach' of the ions of 4·45 A., which is sufficiently large to make the higher terms in the extended theory of Gronwall, La Mer and Sandved negligible. The equation proposed by Hitchcock, $-\log f = \alpha\sqrt{c} - Bc$, did not give satisfactory results. Harned and Nims have published results for activity coefficients of sodium chloride obtained with amalgam cells not involving liquid junctions, and these fall on the same curve as the present ones if they are adjusted so as to coincide at 0·1 N concentration. The values of the Hückel constants found by Harned and Nims for the more concentrated solutions used do not, however, agree with those found with dilute solutions by Brown and MacInnes, whose results extend to 0·05 N.

ERRATUM. In the paragraph entitled "Structure of Keratin" (NATURE, Oct. 5, p. 557, lines 21 and 22), for "were respectively normal and parallel to the flat surface" read "were respectively parallel and normal to the flat surface".

Sixth International Botanical Congress

AMSTERDAM MEETING

ABOUT nine hundred members, including delegates from more than fifty countries, attended the sixth International Botanical Congress at Amsterdam in the first week in September. The much-regretted death of Prof. F. A. F. C. Went had, a few weeks previously, deprived the Congress of its president. His place was taken by Prof. J. C. Schoute, who, in welcoming the members at the opening meeting, referred to the great loss to botany and to their regret that the directing hand had been unable to carry the work to completion.

The papers in the various sections were given by invitation of the executive committee, and were grouped under headings. A great variety of subjects were included, of special and general interest, the latter often affording combined meetings with other sections. Thus the evolution of angiosperms interested palæobotany and taxonomy, flower morphology attracted taxonomists as well as morphologists, and "Taxonomy and Genetics" had an obvious dual interest. Joint discussions were indicated between cytology and genetics, between each of these and mycology, between agronomy and phytopathology or physiology and so on. The programme, a marvel of condensation in three languages, informed members as to subject, date and place of meeting, and a volume of abstracts of the papers provided a useful handbook. Members interested in special studies found opportunity for informal meeting and discussion.

The Nomenclature Section of Taxonomy, under the presidency of Dr. Merrill, worked through a series of proposals, the main purpose of which was to clarify points, where desirable, in the recent edition of the "Rules of Nomenclature". Certain additions suggested by the palæobotanists to meet difficulties, arising especially from the fragmentary character of the material, were accepted.

An admirable "History of Botany in the Netherlands" had been prepared by the senior secretary, Dr. M. J. Sirks, and a pamphlet by Prof. Leeuw described in detail the Netherlands as an environment for plant life.

Linnæus was a student at Leyden, and his early botanical work was done in Holland. The bicentenary of the publication of his "Systema Naturæ" (Leyden, 1735) was commemorated by an appropriate exhibit of Linneana at Amsterdam during the Congress.

Days reserved for excursions gave opportunity for visiting botanical laboratories and gardens, as at Utrecht, Leyden, Baarn. Special care was taken by those in charge to make the visits instructive and interesting. The botanical garden at Leyden is one of the oldest in Europe. Founded in 1587, it was laid out under the supervision of Clusius in 1594, and members were shown a replica of his garden recently prepared from an original plan and inventory. More than 1,000 species and varieties were represented, and it showed a character, novel for the time, of a botanical, not merely a medical, garden. At Baarn, the extensive collections of pure cultures of fungi, amounting to 5,000 units, under the care of Dr. Joh. Westerdyk, were visited and at Lisse the admirably equipped bulb research laboratories.

A drive along the old Zuyder Zee and on the dam which now holds back the North Sea was an object lesson in the essentially Dutch art of converting sea-flooded areas into cultivable polderland. Various stages in conversion were seen, culminating in a polder bearing crops and two new villages which five years ago was open sea.

Pleasant social functions were evening receptions by the Netherlands Botanical Society, and, at the Rijksmuseum, by the Netherlands Government; the latter gave opportunity of inspecting the famous picture galleries.

At the final plenary meeting, an invitation from Sweden to hold the meeting in 1940 at Stockholm was accepted. An invitation to meet in South Africa had been withdrawn.

The executive committee is to be congratulated on its successful organisation; special mention is due to the senior secretary, Dr. M. J. Sirks.

A. B. RENDLE.

Twelfth International Congress of Zoology

LISBON MEETING

IN view of the restrictions on foreign travel imposed in several European countries it was expected that the number of members attending the Congress of Zoology which was held at Lisbon on September 15–21 might fall short of that reached at some previous meetings of the Congress. In the event, however, the number proved to be little, if at all, less than that of the last meeting at Padua in 1930. Under the presidency of Prof. Arthur Ricardo Jorge, some five hundred members took part, and the programme showed about two hundred separate communications to be read either before the full Congress or at the sessions of the twelve sections into which it divided.

At the opening meeting, presided over by the President of the Portuguese Republic, the Minister of Public Instruction welcomed the Congress and delivered an address on the place of biology in education, in which he advocated instruction in the principles of biology as a necessary preparation for the teaching of ethics, civics and even politics.

It is not possible here to enumerate even the more important of the communications made to the Congress, but one or two may be mentioned which, for different reasons, happened to interest members of the British delegation. Prof. R. Anthony (Paris) gave an address on the evolution of the molar teeth in mammals, in the course of which he criticised

once again the much criticised 'tritubercular theory'. In this, he was supported by Mr. Hinton, of the Zoological Department of the British Museum. Prof. R. Goldschmidt (Berlin) gave an account of the progress of his long-continued researches on the genetics of local races of the gipsy moth, and came to the conclusion that local races do not represent a stage in the evolution of species. Prof. Przibram (Vienna) demonstrated living specimens of a stick insect in which transplanted legs were voluntarily movable, although sections of similar specimens failed to reveal any connexion with the central nervous system.

Dr. Calman directed attention to the centenary of Darwin's visit to the Galapagos Islands and to the action of the Government of Ecuador in declaring certain of the islands a Nature reserve. The Congress adopted a resolution expressing its appreciation of the step taken by the Ecuadorian Government and offering its co-operation in any further action that might be necessary to preserve from extinction the very interesting fauna of the islands.

Probably no section of the Congress worked harder than the members of the International Commission on Zoological Nomenclature who sat (mostly in their shirt-sleeves!) for several hours each day under the chairmanship of Dr. Jordan of Tring, striving to disentangle the complexities of the problems submitted to them. For the first time in many Congresses, they met without their indefatigable secretary, Dr. C. W. Stiles, of Washington, who was prevented by illness from travelling to Lisbon. The result of their labours was the addition to the official list of *nomina conservanda* of a considerable number of generic names, mostly of insects, that were threatened with displacement or transference by a strict application of the rule of priority.

Unfortunately, some of the rooms where the meetings were held proved defective in their acoustic qualities. In particular, the lofty hall used for the plenary sessions, being lined with polished marble, provided an excellent demonstration of the reflection of sound. Since each speaker used a language which was foreign to some eighty per cent of his audience, effective discussion was impossible except where an abstract of the paper had been supplied beforehand. It is to be hoped that at future Congresses an attempt will be made to print abstracts of all papers and to distribute them well in advance of the opening day, and perhaps even to supply the full text of the more important addresses.

Finally, mention should be made of the lavish hospitality shown to the Congress by the Portuguese Government, the Municipality and the University of Lisbon, and the Municipality of Sintra, as well as by the Portuguese zoologists themselves. Many northern zoologists, making acquaintance for the first time with the brilliant sunshine, the blue sea, and the subtropical vegetation of Portugal, will not soon forget the friendliness of their Portuguese colleagues.

International Meteorological Conference

WARSAW MEETING

THE International Meteorological Conference is an assembly, which meets every six years, of the directors of meteorological services in all parts of the world. A meeting was due in 1935, and by invitation of Dr. J. Lugeon, director of the National Meteorological Service of Poland, it was held in the Palais Stasjic, Warsaw, on September 6–13 under the presidency of Prof. E. van Everdingen. The conference was formally opened by the President of the Republic of Poland on September 6, and an address of welcome was delivered by the Minister of Communications. Only directors can be members of the full conference, but much of the detailed work of organisation is carried out by commissions nominated for special subjects, and each commission is composed of those meteorologists who are most expert in the work of the commission. Meetings of nearly all the commissions were held either in Warsaw before and during the main conference, or in Danzig during the preceding week.

The work of the conference and commissions covers a very wide field—synoptic meteorology, investigation of the upper air, climatology, agricultural meteorology, maritime meteorology, terrestrial magnetism, bibliography, etc., with many ramifications of detail. Synoptic meteorology, including the taking of observations at agreed hours, their broadcasting in code, reception and plotting on charts, has required the building up of an international organisation of great complexity, which is of vital importance not only for daily weather forecasting, but also for aviation. The extension of regular long-distance flying, in particular, has had the result that pilots pass from one country to another, and need to consult a variety of different weather charts, not only for the general isobars and winds, but also for details such as the form and height of clouds, or the presence of fog, thunderstorms, etc. To avoid confusion, the observations must be made and coded in a uniform manner —for which purpose detailed instructions in the use of the codes have been drawn up for international use. It is equally important, however, that the weather reports should be entered on the weather charts of different countries, according to a general plan, so that the pilot knows at once exactly where to look for the particular information which he requires. This 'station model', as it is termed, has been the subject of very careful consideration at Warsaw by the Commission for Synoptic Weather Information, and a great measure of agreement has been arrived at as to the form which it should take.

Another subject studied by this commission also concerns the international language of meteorology, namely the symbols used to represent various meteorological phenomena. At Warsaw, several new symbols, especially one for drizzle, were added to this international language. Finally, among a number of minor improvements in the codes for weather reports must be signalised the beginning of the arrangements for the inter-continental exchange of weather information by wireless, with the view of preparing within a few hours daily weather

charts for a hemisphere, if not for the whole world.

The great importance of weather in aviation necessitates close relations between meteorological services and the authorities in charge of air lines. To meet this need, the conference at Warsaw formed a new commission, the purpose of which is to keep in close touch with the requirements of aviation, and to maintain and develop as required the meteorological organisation necessary for this purpose.

Another aspect of synoptic meteorology to which reference must be made is the construction of detailed daily charts of the northern hemisphere, now being prepared by the Deutsche Seewarte with international co-operation for the whole period of the Polar Year 1932–33. As reported by the Polar Year Commission, the preparation of these charts is progressing, though difficulty is being experienced in obtaining data for some of the more remote parts of the northern hemisphere. When completed, these charts will be of the greatest value for studies in dynamical meteorology.

The tendency towards internationalisation has appeared also in the domain of climatology, in the form of an international 'alphabet' for the headings of columns. Thus the column, for example, for 'pressure' in a climatological table should bear the letter *P*, no matter what country issues the table. The Climatological Commission has also devised a standard form of table for the guidance of meteorological institutes. Months are designated I–XII, but both in climatology and in agricultural meteorology the need has been felt for the use of a unit of time shorter than a month and there has been great discussion of the relative advantages of the 5-day period, or pentad, and the week, with the result that both units have received international approval.

The Commission for Terrestrial Magnetism and Atmospheric Electricity was occupied mainly with questions of detail. Among the resolutions were also appreciations of the action of the British Admiralty in deciding on the construction of a non-magnetic ship specially designed to carry on the researches formerly made on the ill-fated *Carnegie*, and of the Canadian authorities in transforming the temporary geophysical station erected at Chesterfield Inlet for the Polar Year into a permanent station.

The report of the Commission for Bibliography, which was unanimously adopted by the conference, presented a new plan of classification for meteorological literature, affiliated to the decimal classification of the International Institute of Bibliography, but thoroughly revised. This classification has been studied and discussed for several years, and its completion will greatly facilitate bibliographical work in meteorology.

The work of an international conference does not end with the formal debates and resolutions; there remain many problems which can only be resolved by private discussion among the members. The value of the Warsaw conference was greatly increased by the presence of delegates from all parts of the world. Africa was especially well represented, and the practical problems of organisation in that difficult continent were fully explored.

On Sunday, September 8, an all-day excursion was made to the new aerological and radiometeorological observatory at Jablonna, which owes its inception to Dr. Lugeon, and which promises to be of as great importance in studies of the ionosphere in Poland as is the station at Slough, in England. On the evening before the final meeting, H.E. the Minister of Communications entertained members and their wives to a State banquet, where all speakers reflected the spirit of optimism prevailing in meteorology to-day, which was the keynote of the whole conference. After the meeting, many of the delegates proceeded to Cracow and the Tatra Mountains on an excursion which was admirably organised and provided an experience not readily to be forgotten.

Biochemistry in Relation to Therapeutics

SIR FREDERICK GOWLAND HOPKINS delivered the inaugural sessional address at the opening of the ninety-fourth Session of the College of the Pharmaceutical Society on Wednesday, October 2. His address included a wide survey of the needs of pharmacy to-day and of the educational means for satisfying them, and led him to examine a problem as old as education itself, the problem of how far vocational training is compatible with true education in which a subject is studied for its own sake as an intellectual exercise. It has often been said that science can only be taught properly when it is taught as pure science without reference to its applications. This claim is justified to the extent that vocational needs must not make the teaching of science so one-sided that the student risks missing the intellectual stimulus which the great generalisations of science provide.

Teachers of applied scientific subjects will be grateful to the president of the Royal Society for his declaration that the skilful teacher of students whose ultimate aim is to apply science in practice, can illustrate general principles adequately while selecting facts and aspects which have a permanent vocational value. Indeed, for the encouragement of the average student, it is important that the reality of this permanent value should be part of his faith. Without it he can never be an enthusiast for his calling. The preference for vocational training may well be based on the Anglo-Saxon preference for action rather than thought and for practice rather than theory, but it is an attitude of mind having in it the seeds of certain dangers. Indeed, a distrust of theory has sometimes kept Great Britain from being in the van of intellectual and not less of commercial progress: "It was because it had become really scientific that the medical knowledge of another country received for a long period and up to the time of the War the greatest respect in the world and it was because its chemists were so fully trained in theory that the same country obtained among other similar advantages a long lead in the production of synthetic drugs which rightly or wrongly brought it enormous profits".

On the same occasion Sir Frederick Gowland Hopkins took occasion to review the present state of biochemistry; in particular, in its relation to

therapeutics. As he pointed out, while the structure of a drug administered as a medicine may be known, very little has been known about the nature of the events in the tissues of the body which are affected by the drug. The pharmacologist relies upon the obvious and visible reaction of the body as a whole to the drug when administered, or at least, of the reaction of a specific organ as a whole. His observations throw little light upon the precise and intimate mechanism of the drug's action. This is the province of biochemistry, and modern biochemistry is fast acquiring methods which enable it to follow the progress of the invisible molecular events which occur in the tissues while they are living.

Biochemistry should in the future be able to describe in detail the numerous chemical reactions which proceed in ordered sequence in every living tissue cell. The great majority of drugs act by intruding among these chemical reactions and by modifying their course or by entering relations with the enzymes which catalyse these reactions. When we know into what kind of reaction and at what stage in its progress a given kind of molecule intrudes, or when we know exactly the chemical nature of the enzyme with which, owing to mutual structural affinities, it makes sufficient contact, then we shall be in a better position for understanding just why the details of its molecular structure confer upon each drug a particular physiological activity. Biochemical investigation of the relationships of the vitamins and hormones has led to the view that it is nearly, if not quite, justifiable to look upon a vitamin as a hormone which the body cannot make for itself, or on a hormone as a vitamin which it does make for itself.

Educational Topics and Events

ST. ANDREWS.—Mrs. Low of Blebo has given £1,000 to the University for the purpose of founding in memory of her son, the late Capt. W. A. Low, a Gold Medal and prize to be awarded annually to the student adjudged to have had the most distinguished course among those graduating in the year as M.B.,Ch.B. The foundation will be named "The Captain W. A. Low Memorial Prize".

The Court has appointed Dr. James A. Macdonald to be a lecturer in botany in the United College.

Dr. James F. Murray, lecturer in bacteriology in the Medical School, Dundee, having resigned that post, the Court has appointed Dr. Alexander B. Stewart, presently assistant in the Department, to the vacant lectureship.

In the old Parliament Hall, St. Andrews, on Friday, October 4, Dr. E. T. Copson was inducted to the chair of mathematics and Dr. R. C. Garry to the chair of physiology, both in University College, Dundee.

AMONG the university extension and tutorial classes arranged by the University Extension Committee of the University of London is a series of lectures on the human mind to be delivered by Prof. Cyril Burt in the City L.C.C. Literary Institute beginning on January 15, and a series on recent discoveries in psychology by Dr. C. E. Allen being given in the lecture hall of the public library, Croydon, which began on October 9. Other lectures on psychology are being delivered by Mr. E. Miller, Mrs. G. R. Blanco-White and Mr. C. E. M. Joad, at Morley College, and the Rev. F. E. England in Whitefield's Central Mission. Apart from these courses in psychology, the only other series of lectures of scientific interest is that by Prof. W. B. Brierley on the biological sciences and modern problems at Gresham College, which began on October 2. A complete list of the lectures can be obtained from the University Extension Registrar, University of London, South Kensington, S.W.7.

THE appeal for new buildings for Birkbeck College (University of London) was launched at a meeting arranged by Lord and Lady Luke at 29 Portman Square on October 2. Lord Luke, chairman of the Appeal Committee, announced that His Royal Highness the Duke of York has consented to accept the presidency of the College and will be present with the Duchess at a meeting at the Mansion House on November 7 when the Lord Mayor and Mr. Ramsay Macdonald, both old students of the College, will speak on the needs of Birkbeck. Mr. Hichens, chairman of the Governors, referred to the grant by the University of London of space for the new buildings on the University site in Bloomsbury, and Dame Helen Gwynne-Vaughan spoke of the good work of Birkbeck students. As is well known, Birkbeck College is a school of the University of London for evening and part-time students who are prevented by their employment from attendance at a college during the day. In the Science Departments, an increasing number of students come from large research laboratories under the auspices of the Department for Scientific and Industrial Research or of private firms. A special feature of the College is the strength of the postgraduate work; each year sees the publication of numerous contributions to knowledge resulting from the work of staff and students. Opportunity for investigation is given to a large number of capable men and women.

IN university circles in the United States there is widespread anxiety as to the curtailment of academic freedom. Leaders in the learned world denounce the 'brutal tyrannies' under which in more than one foreign country the expression of opinions and even the dissemination and discussion of information in universities have been stifled. Of three graduation addresses by the presidents of Harvard, Yale and Princeton, respectively, published in *School and Society* of July 13, two contain such denunciations, and one disparages the extravagant faith, so common in this age, in the efficacy of idealised social systems such as Communism and Fascism as devices for lifting humanity by its own bootstraps. A week earlier, the well-known chancellor (S. P. Capen) of another university held forth on a similar occasion on "The Obligation of the University to American Democracy". He contrasted the functions of universities in countries such as Italy, Germany and Russia, where there are dictatorships, and in democratic countries. In the former these functions have been simplified and the universities have become, in so far as they concern themselves with the social sciences, organs of propaganda. In the latter, in so far as they are true to democratic principles, the method of the propagandist is abhorrent to them. Nevertheless, in the United States alone among democratic countries, the procedure of universities in this respect is, we are told, challenged and they are constantly being attacked for "teaching socialism or pacifism or atheism or communism, or all of them together".

Science News a Century Ago

Captain Back's Arctic Expedition

The Times of October 13, 1835, contained a statement by William Bowles, the chairman of the Arctic Land Expedition, to the subscribers who financed the expedition. In the course of the statement, he reviewed the circumstances which led to the project of sending out a party to find Captain Ross, referred to the eminent services of Captain Back, his companion Mr. King the surgeon and to the assistance given in the United States and Canada and to the eight men who had made the boat journey to the coast with Captain Back. The subscriptions, Mr. Bowles said, included £2,000 from the Government, £500 from the Hudson's Bay Company, £105 from the Lord Mayor and Corporation of London, £105 from the Committee of Lloyds and £100 from the Corporation of Trinity House. "The Committee," he said, "has the highest possible gratification in announcing that, on the recommendation of the Lords Commissioners of the Admiralty, His Majesty in Council has been pleased to grant an order, dispensing in Captain Back's case, with the actual service afloat, which according to the rules of the Navy, would have been otherwise requisite to qualify him for a step in his profession. He has thus been promoted in the most gracious manner, without delay; and a munificent individual (Robert Holford, Esq., of Westcliff, Isle of Wight) has remitted 100£ to be divided in equal shares among his boat's crew, the partakers of his greatest difficulties and dangers".

Lyell and Mantell

SHORTLY after his return home from his tour in France, Switzerland and Germany, Lyell on October 14, 1835, wrote from London to Dr. Gideon Mantell at Brighton giving him an account of some of his geological excursions. In the course of his letter, he said: "I entered Switzerland by Porrentrui, and there I had Thurmann for my guide, who gave me in a short time a beautiful insight into the structure of the Jura . . . and I was glad to verify his observations in the field, and to see his beautiful collection of Jurassic shells, and his attempt to assimilate the oolitic series and their fossils of the Swiss Jura with our English oolitic groups. I afterwards had a work in another part of the Jura with some geologists at Neuchâtel, where the chalk, as it appears to me by its fossils, fills the bottom of the valleys of the Jura limestone. I next had a work with Studer at Berne, and then had a work of about six weeks in that part of the Swiss Alps which is called the Bernese Oberland. . . . People seem to be in high spirits here on the success of the Dublin meeting. Agassiz looks in good health, and is satisfied with the great progress he has made, and looks forward with great pleasure to a first visit to Brighton. . . . I have been writing this by candle-light after the labours of the day, and as you know my eyes of old, you will excuse its not being in my own handwriting. . . ."

Prof. Tiedemann in Edinburgh

ON October 17, 1835, quoting from the *Scotsman*, *The Times* said: "The celebrated Professor Tiedemann of Heidelberg has been in Edinburgh for some days. He is collecting materials for a work on the comparative anatomy of the brain and has visited London, Glasgow and Dublin. In Edinburgh he has pursued his researches in the Museum of the Royal College of Surgeons, the College Museum and the Museum of the Phrenological Society, which last he has visited on three successive days for the purpose of weighing and measuring the skulls of different nations". Tiedemann, who was born at Cassel in 1781 and died in 1861 at the age of seventy-nine years, was made professor of zoology, anatomy and physiology at Heidelberg in 1816.

Societies and Academies

PARIS

Academy of Sciences, August 26 (*C.R.*, 201, 461–476). MARCEL DELÉPINE: The work of the late Antoine Nicolas Guntz. PIERRE DE VANSSAY: Drawing the azimuth line on a Mercator projection. S. CARRUS: The successive evolutes of a skew curve. ARNAUD DENJOY: Groups of homographic substitutions. RAPHAËL SALEM: The generalisation of certain lemmas of Van der Corput and applications to trigonometrical series. MARCUS FRANCIS: The electrolytic method of preparing thin deposits of U_3O_8. Starting with a salt of uranium not carefully purified, other radioactive substances deposit first during electrolysis and a satisfactory deposit of uranium oxide cannot be obtained. LUBOMIR DONTCHEFF and CHARLES KAYSER: The signification of respiratory coefficients below 0·7 in certain poecilotherms.

September 2 (*C.R.*, 201, 477–492). HENRY GAULT and MATUS COGAN: Formyltropic ester. This is produced by the condensation of formylphenylacetic ester with formaldehyde. FRANÇOIS DUPRÉ LA TOUR: Polymorphism in the series of the normal fatty diacids. JACQUES DE LAPPARENT: An essential constituent of fullers earth. HENRI LONGCHAMBON: The essential mineralogical constituents of clays, and especially of fullers earth. ANDRÉ CAILLEUX: Traces of important interglacial aerial action in Poland. GEORGES BOURGUIGNON: Chronaxy in voluntary movement and in pain in normal man. Static chronaxy and dynamic chronaxy. MME. ISABELA POTOP: Researches on the acid-soluble phosphorus, the mineral phosphorus and the ultrafiltrable phosphorus of the blood.

September 9 (*C.R.*, 201, 493–508). The president announced the death of LÉON FREDERICQ, *Correspondant* for the Section of Medicine and Surgery. PAUL LÉVY: The law of large numbers for connected variables. G. PFEIFFER: A special method of integration of complete systems of linear partial differential equations of the first order of an unknown function. ARNAUD DENJOY: The geometry of homographic groups. ANDRÉ BRIOT and BORIS VODAR: The absorption spectra in the ultra-violet of gaseous, dissolved or liquid ammonia. PIERRE DONZELOT and MAURICE CHAIX: The Raman spectra of substances with two benzene nuclei. The substances examined included diphenyl and compounds of the type $C_6H_5.X.C_6H_5$, where X was CH_2, O, S, Se, CH(OH) or Hg. MLLE. BERTHE BIECHELER: The existence of a chromatic cyclosis in the peridineans. JOSEPH KAHN and MME. LUBOV CHEKOUN: The disengagement of ammonia by the brain, following a state of natural stimulation.

AMSTERDAM

Royal Academy of Sciences (*Proc.*, 38, No. 7, September 1935). C. U. ARIËNS KAPPERS: Stability and variability of Central and Palæo-Asiatic index maxima and some remarks on the Greenland Eskimo. G. VAN ITERSON, JR. and J. COUMOU: A few remarks on the iodine-amylum reaction. Discussion of the nature of the blue complex and observations of the temperature of gelatinisation of starch in the presence of iodine and potassium iodide, separately and together. A relatively large rise of the gelatinisation temperature was observed in the last case. J. A. SCHOUTEN and J. HAANTJES: On general conformal geometry in projective treatment. A. A. NIJLAND: Mean light curves of long period variables. (24) *R. Lacertae*. The light of this star varies with a period of 299 days and an amplitude of 5·07 magnitudes. H. R. KRUYT and H. G. BUNGENBERG DE JONG: Extension of the theory of complex coacervation to ionic disperse systems. Experiments showing that coacervation (unmixing) occurs not only in colloidal solutions but also in supersaturated solutions of electrolytes. MISS A. M. HARTSEMA and A. H. BLAAUW: Shifting of periodicity by means of high temperatures. Adaptation and export to the southern hemisphere (2). By keeping daffodil bulbs at 28° until the next spring they can then be exported to the southern hemisphere to flower in late August. J. H. GISOLF: A demonstration experiment concerning the use of a Lummer plate. Shows the resolving power is markedly dependent on the direction of polarisation of the incident light, being greatest when the electric vector is parallel to the plane of the plate. A. ELLIOTT: A note on the β bands of boron monoxide. Data on the magnitude of the spin doubling in these bands, the existence of which had been questioned by Funke and Simons. V. HLAVATY: On conformal geometry (2). Applications particularly to the problem of the affine normals. C. S. MEYER: Integral expressions for Lommel and Struve functions (2). J. W. A. VAN KOL: Correction of some numbers of biquadratic space-curves of the first kind. There are 540 curves k^4 which meet four given straight lines. F. W. WENT: Coleoptile growth as affected by auxin, aging and food. Experiments on the function of auxin in which the auxin content is artificially increased. E. FREY: Experimental researches on the nucleus basalis opticus in the porpoise. E. FREY: The nucleus basalis opticus of the porpoise. T. KUROTSU: On the nucleus magnocellaris periventricularis in reptiles and birds. H. G. BUNGENBERG DE JONG and J. BONNER: Phosphatide autocomplex coacervates as ionic systems and their relation to the protoplasmic membrane. Suggests that the special properties of the protoplasmic membrane depend upon one or more double layers of oriented phosphatide ions similar to the double films of the phosphatide auto-complex coacervate.

CAPE TOWN

Royal Society of South Africa, July 17. A. J. H. GOODWIN: Recent changes in terminology in European prehistory. The term Clacton has been introduced in Europe to cover a flake culture which divides the Chellean and Acheulean. When Gabriel de Mortillet first organised the prehistoric period of France into a single chronological scheme, the site at Le Moustier shelter was made the type site of a major period. Later work by Commont on the gravels of the Somme River necessitated the introduction of the term Levallois to cover part of the complex present at Le Moustier. Recent work by Dr. Ami at Combe Capelle, and by Henri Martin at La Quina have rendered a further analysis necessary. As a result, the Le Moustier site is now regarded as presenting three cultural themes, which here mingle: the Levallois, the true Moustierian, and the Acheulean tradition. Afterwards Péyrony, Breuil and others have shown these themes in their earlier forms, and terms have been applied to cover these developments.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, October 13

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. Susan Finnegan: "Spiders".*

Monday, October 14

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "Egg-Laying Mammals".*

UNIVERSITY OF LEEDS, at 5.15.—E. O. G. Turville-Petre: "Iceland".*

Tuesday, October 15

UNIVERSITY COLLEGE, LONDON, at 3.—Prof. B. Ashmole: "Greek Sculpture".*

KING'S COLLEGE, LONDON, at 5.30.—A. Ramsay Moon: "Electric Welding as Applied to Structural Work" (succeeding lectures on October 22 and 29).*

GRESHAM COLLEGE, at 6.—A. R. Hinks: "Our Sun's Neighbours" (Gresham Lectures on Astronomy. Succeeding lectures on October 16, 17 and 18).*

BRITISH INSTITUTE OF PHILOSOPHY, at 8.15.—(in University College, Gower Street, W.C.1).—The Right Hon. Sir Herbert Samuel: "New Science and Old Philosophy". (Presidential Address.)

Wednesday, October 16

SOCIETY OF GLASS TECHNOLOGY, at 2.—(at the University of Sheffield). B. P. Dudding: Presidential Address.

Thursday, October 17

BRITISH INSTITUTE OF RADIOLOGY, at 8.—(in the Reid-Knox Hall).—L. A. Rowden: "Looking Backward and Looking Forward" (Presidential Address).

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Sir Arthur Bagshawe: Presidential Address.

Friday, October 18

ROYAL ASIATIC SOCIETY, at 4.15.—Prof. John Garstang: "Further Discoveries at Jericho".

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6.—Dr. John T. Batey: Presidential Address.

Official Publications Received

Great Britain and Ireland

Brighton Technical College. Calendar, Session 1935–36. Pp. 119. (Brighton: Technical College.)

British Medical Association. Family Meals and Catering. Pp. 27+3 plates. (London: British Medical Association.) 6*d*.

Spanish Influence on the Progress of Medical Science: with an Account of the Wellcome Research Institution and the Affiliated Research Laboratories and Museums founded by Sir Henry Wellcome. Commemorating the Tenth International Congress of the History of Medicine, held at Madrid, 1935. Pp. 121. (London: Wellcome Research Institution.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 19: The Female Reproductive System in the Guinea-Pig; Intravitam Staining, Fat Production, Influence of Hormones. By Dr. Thomas Nicol. Pp. 449–486+6 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.). 8*s*. 6*d*.

Rothamsted Conferences. 20: The Cause and Control of Swarming in Bees. Contributions by Brother Adam, Miss A. D. Betts, C. F. Clay, W. Hamilton, D. Morland, W. H. J. Prior, L. E. Snelgrove. Pp. 31. (Harpenden: Rothamsted Experimental Station.) 1s. 6d.

Annals of the Cape Observatory. Vol. 14, Part 1: Stellar Parallaxes (1st Series) determined in the Years 1926–1930 with the Victoria Telescope of the Royal Observatory, Cape of Good Hope, under the direction of Dr. H. Spencer Jones; completed for publication under the direction of Dr. J. Jackson. Pp. xvii+119. (London: H.M. Stationery Office.) 12s. net.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 11: Chromosome Numbers in the Malvaceæ, 1. By A. Skovsted. Pp. 263–296. (London: Empire Cotton Growing Corporation.) 2s. 6d.

Annual Report of the Director of the Meteorological Office, presented by the Meteorological Committee to the Air Council, for the Year ended March 31, 1935. (M.O. 388.) Pp. 47. (London: H.M. Stationery Office.) 9d. net.

Department of Scientific and Industrial Research. Forest Products Research Records, No. 1: The Testing of Timbers at the Forest Products Research Laboratory. Pp. ii+8. 6d. net. Forest Products Research Records, No. 2 (Timber Mechanics Series, No. 1): Strength Tests of Structural Timbers. Part 1: General Principles with Data on Redwood from Gefle and Archangel. By C. J. Chaplin and J. Latham. Pp. ii+10. 6d. net. (London: H.M. Stationery Office.)

Potato Marketing Board. Miscellaneous Publications, No. 1: The Potato as an Article of Diet. Bibliography and Notes thereon by Dr. W. H. Archbold. Pp. 20. (London: Potato Marketing Board.) 6d.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1934. Survey prepared by B. P. Uvarov. Pp. 65+11 maps. (London: H.M. Stationery Office.) 3s. net.

Joint Committee on Water Resources and Supplies (Session 1934–35.) Vol. 1: Proceedings of the Committee, 3rd to 25th July 1935 (inclusive). Pp. viii. 2d. net. Vol. 2: Minutes of Evidence (11th to 25th July 1935, inclusive), together with an Appendix. Pp. ii+99. 3s. net. (London: H.M. Stationery Office.)

Air Raid Precautions. Memorandum No. 1: Treatment of Casualties and Decontamination of Personnel. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 15. (London: H.M. Stationery Office.) 4d. net.

Other Countries

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 8: The Maintenance of First Year Characters in New Sugarcane Clones. By A. Glendon Hill. Pp. 7+8 plates. (Port Louis: Government Printer.)

Southern Rhodesia: Geological Survey. Bulletin No. 28: The Geology of the Makaha Gold Belt, Mtoko District. By A. M. Macgregor. Pp. 47+1 plate. (Salisbury: Government Stationery Office.) 1s. 9d.

Transactions of the San Diego Society of Natural History. Vol. 8, No. 10: The Mangrove Warbler of North-Western Mexico. By A. J. van Rossem. Pp. 67–68. Vol. 8, No. 11: A New Race of Brown Towhee from the Inyo Region of California. By A. J. van Rossem. Pp. 69–72. Vol. 8, No. 12: A New Silky Pocket Mouse from Sonora, Mexico. By Laurence M. Huey. Pp. 73–74. Vol. 8, No. 13: A New Sub-species of *Crotalus confluentus*, the Prairie Rattlesnake. By Laurence M. Klauber. Pp. 75–90+plate 8. Vol. 8, No. 14: New or Little-known Crabs from the Pacific Coast of Northern Mexico. By Steve A. Glassell. Pp. 91–106+plates 9–16. Vol. 8, No. 15: A New Genus and Species of Pigmy Goose from the McKittrick Pleistocene. By Roland Case Ross. Pp. 107–114. (San Diego, Calif.: San Diego Society of Natural History.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 20: Fibre-Maturity in relation to Fibre and Yarn Characteristics of Indian Cottons. By Amar Nath Gulati and Dr. Nazir Ahmad. Pp. 31. (Bombay: Indian Central Cotton Committee.) 8 annas.

Thirty-second Annual Report of the Bureau of Science, Philippine Islands, for the Year ending December 31, 1933. By Arthur F. Fischer. Pp. 95. (Manila: Bureau of Printing.)

Brooklyn Botanic Garden Record. Vol. 24, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1935–36. Pp. xii+195–228. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.)

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 54. Alaska—Yukon Caribou. By Olaus J. Murie. Pp. 93+10 plates. (Washington, D.C.: Government Printing Office.) 20 cents.

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga, June–October 1933. Section 4, Part 2: Contributio ad cognitionem floræ Manshuricæ. By Takenoshin Nakai, Masaji Honda and Masao Kitagawa. Pp. iv+187+19 plates. Section 5, Division 1, Part 2: Crustacea of Jehol. By Masuzô Uéno, Tune Sakai and Hajime Uchida. Pp. iv+16+16+8+6+4+19 plates. Section 6, Part 1: Contribution to the Prehistoric Archæology of Southern Jehol, by Ichiro Yawata; On the Chemical Investigation of a Bronze Vessel unearthed in the vicinity of Pei-Piao in Chao-Yang Prefecture, by Tsurumatsu Dôno. Pp. ii+106+29 plates. (Tokyo: Waseda University.)

Daily Meteorological Observations taken at St. George's, Bermuda, during the Polar Year, August 1932–August 1933. Pp. 32. (Bermuda: Meteorological Office.)

Meteorological Observations in Nigeria during the Polar Year 1932–33. Compiled under the direction of the Surveyor-General. Pp. viii+95. (Lagos: Survey Department.)

Annual Report of the Imperial Council of Agricultural Research for the Year 1933–34. Pp. iv+141. (Delhi: Manager of Publications.)

The Imperial Council of Agricultural Research. Scientific Monograph No. 5. The Bombay Grasses. By Dr. E. Blatter and C. McCann. Pp. xxii+324+189 plates. 20.12 rupees; 32s. 6d. Scientific Monograph No. 6: Helminth Parasites of the Domesticated Animals in India. By G. D. Bhaleras. Pp. iii+365. 7.12 rupees; 13s. 3d. (Delhi: Manager of Publications.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 155: Evaporation and Deterioration of Cut Cane in Egypt. By Arthur H. Rosenfeld. Pp. 26. 3 P.T. Bulletin No. 159: A Mealy Bug new to Egypt (*Pseudococcus brevipes*, Ckll.) on Roots of Phœnix sp. and its Control by the Application of Chemicals to the Soil. By M. Hosni and Dr. M. Shafik. Pp. 8+3 plates. 2 P.T. Bulletin No. 160: Efficiency of Commercial Sodium Cyanide and Sulphuric Acid in liberating Hydrocyanic Acid Gas for Fumigation. By Dr. M. Shafik and A. A. Amer. Pp. 6. 2 P.T. (Cairo: Government Press.)

Union Géodésique et Géophysique Internationale. Travaux de l'Association Internationale de Géodésie. Tome 11: Rapports nationaux sur les travaux exécutés dans les différents pays établis à l'occasion de la cinquième Assemblée générale, Lisbonne, 14–25 Septembre 1933. Fasc. 3. Pp. iii+10 papers. (Paris: Association Internationale de Géodésie.) 140 francs.

U.S. Department of the Interior. Geological Survey. Water-Supply Paper 742: Surface Water Supply of the United States, 1933. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vii+206. 30 cents. Water-Supply Paper 743: Surface Water Supply of the United States, 1933. Part 3: Ohio River Basin. Pp. ix+357. 25 cents. Water-Supply Paper 746: Surface Water Supply of the United States, 1933. Part 6: Missouri River Basin. Pp. viii+276. 20 cents. Water-Supply Paper 750: Surface Water Supply of the United States, 1933. Part 10: The Great Basin. Pp. v+107. 10 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture: Bureau of Entomology and Plant Quarantine. Miscellaneous Publication No. 220: Directory of the Bureau of Entomology and Plant Quarantine. Pp. 88. (Washington, D.C.: Government Printing Office.) 10 cents.

Cornell University: Agricultural Experiment Station. Bulletin 622: Dry Concentrates as a Partial Substitute for Whole Milk in Calf Rations. By E. S. Savage and C. H. Crawford. Pp. 29. Bulletin 623: Mobility of Rural Families, 2: Changes in Residence and in Occupation of Sons and Daughters in Rural Families in Genesee County, New York. By W. A. Anderson. Pp. 37. Bulletin 624: Investigations in Pruning Mature Apple Trees. By Joseph Oskamp. Pp. 42. Bulletin 625: A Critical Study of the Methods for Measuring Oxidation-Reduction Potentials of Soils, with special reference to Orchard Soils. By Michael Peech and L. P. Batjer. Pp. 23. Bulletin 626: Soils in relation to Fruit Growing in New York. Part 6: Tree Behavior on Important Soil Profiles in the Williamson-Marion Area, Wayne County. By Joseph Oskamp. Pp. 29. Bulletin 627: Soils in relation to Fruit Growing in New York. Part 7: Tree Behavior on Important Soil Profiles in the Kinderhook, Germantown and Red Hook Areas in Columbia and Dutchess Counties. By L. P. Batjer and Joseph Oskamp. Pp. 30. Bulletin 631: Interests, Activities and Problems of Rural Young Folk, 2: Men 15 to 29 Years of Age. By W. A. Anderson and Willis Kerns. Pp. 43. Bulletin 632: Greensprouting Seed Potatoes. By E. V. Hardenburg. Pp. 29. Memoir 173: Biology of the Midge *Chironomus tentans* Fabricus, and Methods for its Propagation. By William O. Sadler. Pp. 25. Memoir 175: Effect of Temperature on Pollen Germination and Tube Growth in the Tomato. By Ora Smith and H. L. Cochran. Pp. 11. Memoir 178: Synthetic Diets for Herbivora, with special reference to the Toxicity of Cod-Liver Oil. By L. L. Madsen, C. M. McCay and L. A. Maynard; with the cooperation of George K. Davis and J. C. Woodward. Pp. 53. (Ithaca, N.Y.: Cornell University.)

Bulletin of the National Research Council. No. 97: A Table of Eisenstein-Reduced Positive Ternary Quadratic Forms of Determinant $\leqq 200$. By Burton W. Jones. Pp. 51. 1 dollar. No. 98: Report of the Committee on Sedimentation 1932–1934. Pp. 246. 1 dollar. (Washington, D.C.: National Academy of Sciences.)

U.S. Department of Agriculture. Technical Bulletin No. 482: Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics. By Horace G. Byers. Pp. 48. (Washington, D.C.: Government Printing Office.) 5 cents.

Elihu Root Lectures of Carnegie Institution of Washington on The Influence of Science and Research on Current Thought. Popular and Unpopular Science, by James R. Angell; The Nature of Progress in Science, by H. A. Spoehr. Pp. v+54. (Washington, D.C.: Carnegie Institution.)

Government of India: Department of Industries and Labour (Public Works Branch.) Irrigation in India: Review for 1933–34. Pp. 53. (Delhi: Manager of Publications.) 1.12 rupees, 3s.

Carte Générale Bathymétrique des Océans. Troisième édition. Sheet A1: North Atlantic Ocean. 1.1 metres × 0.75 metre. (Monte-Carlo: International Hydrographic Bureau.) 35 francs.

Canada: Department of Mines: National Museum of Canada. Bulletin No. 76: Annual Report for 1934. Pp. 25. (Ottawa: King's Printer.) 10 cents.

Canada. Department of Mines: Bureau of Economic Geology: Geological Survey. Memoir 175: Portland Canal Area, British Columbia. By George Hanson. (No. 2371.) Pp. ii+179. 50 cents. Memoir 177: Lake Ainslie Map-area, N. S. By G. W. H. Norman. (No. 2374.) Pp. iv+103+4 plates. 25 cents. Memoir 178: The Mining Industry of Yukon, 1934. By H. S. Bostock. (No. 2387.) Pp. v+10. 10 cents. Memoir 180: Mudjatik-Haultain Area, Saskatchewan. By F. J. Alcock. (No. 2393.) Pp. ii+16+2 plates. 10 cents. (Ottawa: King's Printer.)

Catalogues, etc.

Sankey's New Improved Down-Draught Preventing Pot. Pp. 12. (Ilford: J. H. Sankey and Son, Ltd.)

Catalogue of Microscopes Part 6: Polarizing Microscopes. Pp. 601–632. (London: W. Watson and Sons, Ltd.)

Price List of B.D.H. Laboratory Chemicals. Pp. 195. (London: The British Drug Houses, Ltd.)

Cambridge Electrocardiographs. Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Practical Hints on Patents. By M. E. J. Gheury de Bray. Fifth edition, entirely revised and considerably enlarged. Pp. 48. (London: Imperial Patent Service.) 6d.

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3442 SATURDAY, OCTOBER 19, 1935 Vol. 136

Preservation of Game Animals of the British Empire

A STRAIGHT problem faces the rulers of every part of the British Empire: Is the wild fauna to be left to take its chance at the hands of a native population which has been accustomed to kill without restraint, and in face of the steady encroachments of agriculture, commerce and sport, or is it to be shielded for its own sake and for the sake of posterity? And everywhere the answer is that it must be shielded. Thus a second and more difficult problem is born: To what extent and intensity must protection be carried? For it need scarcely be said (in spite of protection's ultra-enthusiasts) that where a clash arises between wild fauna and human survival or progress, mankind and not its unwitting opponents must have the backing of the State.

Rational legislation for the protection of wild animals (and the protection of the people) must, therefore, endeavour to arrange for preservation without undue multiplication where an animal is already on the down-grade, and for opportunities of destruction—falling far short, it may be hoped, of extinction—where an animal is interfering with the reasonable progress or comfort of humanity. There are few countries in which such rational legislation is in force; for even in lands of long-standing civilisation like our own, where conditions favour detailed and accurate observation, no biological controversies are more strenuous and more indeterminate than those relating to the economic values and the need for preservation or destruction of some of the commonest species. If that is so, how can it be hoped to plan rational laws in the outlying parts of the Empire, where sometimes the need of immediate action seems to be greatest, and where at the same time the balanced knowledge upon which action should be based is least available. Tentative legislation, the effects of which are closely watched and which may be modified at the shortest notice, is the experimental way; but a better way if time allows is to begin by making particular efforts to gather and collate all the information bearing upon the wild fauna in its own relations of numbers, distribution and multiplication, and in its relations to the various activities of humanity, native and non-native. The latter method, with its field surveys and statistics, is being increasingly employed, as every issue of the *Journal of the Society for the Preservation of the Fauna of the Empire* shows; it is exemplified on the best standard in a report just published by the Government of Northern Rhodesia*. The author is Capt. C. R. S. Pitman, game warden in Uganda, whose annual reports on the game of the Protectorate make one of the most interesting and valuable records of the wild life of Africa, and who carried out the Northern Rhodesia survey and investigations in 1931–32 under instructions received through the Secretary of State for the Colonies.

Since the conditions in Northern Rhodesia are fairly representative of conditions in many countries in process of colonisation, the report carries implications of more than local significance. The most general of these is that game, on the whole, has shown a marked decrease in recent years, and that this decrease is progressive, in spite of the fact that a few species have, during the same period, increased enormously in numbers. Natural agencies, as well as man, have contributed to the decrease. Capt. Pitman attributes it, in the first

* A Report on a Faunal Survey of Northern Rhodesia, with especial reference to Game, Elephant Control and National Parks. Pp. xii+500+xxxii+11 maps. (Livingstone, N.R.: Government Printer; London. Crown Agents for the Colonies, 1935.) 7s. 6d. net.

place, to the great rinderpest epidemic of thirty to forty years ago, which over vast areas wiped out the ungulates, particularly buffalo, eland, lechwe, waterbuck, bushbuck, pig and warthog. Before the stock had had time wholly to recover, the Great War came along, and slaughter for the food of the forces again reduced it "practically to vanishing point" in certain of the provinces. From this disaster most of the species have never recovered, and in their reduced numbers incessant harrying by natives armed with muzzle-loading guns (of which nearly 25,000 have been registered by natives) has caused a progressive decline, and in many localities has brought species to that paucity of numbers which is the forerunner of extinction. Finally, the coming of the railway and the development of mining areas have led to the death of several hundred thousand herd at the hands of Europeans.

The general result is that from districts here and there in which they were once common, species are disappearing: where Broken Hill now stands was once one of the best hunting grounds for the greater kudu, the rhinoceros is all but gone from North-Eastern Rhodesia, the blue wildebeest has vanished from the Awemba district, the lechwe from Kawambwa, game generally from the Fort Rosebery District.

Nevertheless, Northern Rhodesia still remains a land well-stocked. An effort to estimate the numbers of game animals, even though it be regarded as only roughly approximate, is full of interest. Amongst the rarer forms are the giraffe (300 individuals), black-faced impala (500), rhinoceros (1,500), yellow-backed duiker (about 1,500), blue wildebeest (2,000), hippopotamus (3,000); while at the other end of the scale are species such as zebra (50,000), buffalo, roan antelope, Lichtenstein's hartebeest, common duiker (all with about 60,000 individuals), and, far and away the most abundant of all, the black and red lechwes (*Onotragus*) numbering 150,000 and 250,000 respectively. The last two species make up nearly half the total ungulate population of about one million, and this, equally distributed, would average about four individuals to the square mile, or approximately the density of the human population throughout the colony.

In this mass of varieties and of numbers, only some half dozen species appear to be able to stem the current of decline, and only three to make headway against it. The ability to withstand an almost universal tendency depends upon different factors in relation to these select animals and is of great significance from an ecological point of view. Thornicroft's giraffe and Cookson's wildebeest owe their present numbers to the co-operation of the local native authorities in protecting these last representatives of particular races, rather than to any natural power of resistance. The lechwe antelopes have been from time immemorial subjected to great slaughter intensified by a system of extensive driving. In spite of statements to the contrary, Capt. Pitman states that great drives still take place, but yet there is no sign of falling numbers, and this can be attributed only to the enormous annual increase of the lechwe herds. The tsessebe antelope (*Damaliscus lunatus*), curious in its distribution because in Barotse it is abundant on the right bank of the Zambezi and completely absent from the left, has not only been able to withstand the general influences, but has actually increased in numbers from hundreds to thousands in post-War days; and this would appear to be due, first, to its habit of keeping in small herds averaging 20–50 individuals, and secondly to a characteristic shyness (or wisdom) which keeps it well out of range of the muzzle-loaders of the natives.

The other two successful species, buffalo and elephant, have multiplied simply because they are large, dangerous animals, not easily tackled with muzzle-loaders. In a buffalo hunt in 1930 when, near the Kafue flats, a herd was driven, according to custom, into a selected swamp, the toll of dead was 30 buffalo and 7 of their native hunters. The amazing rapidity of the increase of this destructive species demands a planned effort at reducing their numbers and maintaining a constant check upon their increase. The same may be said about the elephant, of which there are at least 12,000 in Northern Rhodesia, and which are believed to have trebled in number during the past thirty years. Although there is no general excess, there are districts where the herds are rapidly becoming disturbingly large. The elephant must run no risk of extermination, but the cultivation and the works of man must also be considered. Based upon the rate of increase of the herds, which is estimated at 600 calves a year, Capt. Pitman suggests that control, exacting during the first three years up to a total of 800 individuals, could be organised in such a way that the herds of elephants at present roaming Northern Rhodesia would be shepherded into areas where there was the least chance of their interference with cultivation, and where their numbers could be kept at

the highest level consistent with the welfare of the human population. He is of opinion that, in spite of the low price of ivory (in April 1934 the local African price was 6*s*. 6*d*. per lb.), the control could be carried out by the Government with an excess of revenue over expenditure.

On the much debated question of the relationship between game and the survival of the tsetse fly, Capt. Pitman makes no pronouncement, but he notes that there is a tendency for this noxious carrier of sleeping-sickness (*Glossina morsitans*) to be carried from infected to fly-free areas by mechanical transport along the roads, and as regards game in the fly-belts themselves his conclusion is surely a sound one in the interests of both mankind and wild stock. "In a sparingly populated country like Northern Rhodesia, where 'fly' belts predominate, precluding the possibility of the natives keeping the necessary stock for their meat requirements, it is a duty to the indigenous population—in the absence of a 'fly' specific—to ensure the perpetuation of an adequate quantity of the wild animals from a dietetic point of view, if for no other; and to this end must native opinion be educated."

To strike a just balance between the various interests of mankind and the survival of wild game is no easy matter, and while regulations regarding game licences and the control of game in general, by protection or limited destruction, are essential and helpful, the safety of wild animals in the future is bound up with the establishment and efficient policing of game reserves and national sanctuaries in regions of sparse population, where the promise of native interference is slightest and of permanency greatest. J. R.

Back to Minkowski

Relativity:
an Elementary Explanation of the Space-Time Relations as established by Minkowski, and a Discussion of Gravitational Theory based thereon. By Dr. F. W. Lanchester. Pp. xiv+222. (London: Constable and Co., Ltd., 1935.) 12*s*. net.

DR. LANCHESTER, usually thought of in connexion with aerodynamics and motor engineering, has been interested in the theory of relativity since so far back as 1908, when he met Minkowski soon after the well-known pronouncement that "henceforth space by itself and time by itself will fade to mere shadows, and only a kind of union of the two will remain". The object of the present book is to reconstruct and develop the theory anew, following Minkowski rather than Einstein, and replacing advanced mathematical methods such as the tensor calculus by elementary geometry and algebra, illustrated by a large number of diagrams. On several topics, such as the velocity of light, space curvature, and the expansion of the universe, Dr. Lanchester differs from the usual conclusions.

Chapters i–iv, dealing with the restricted theory, call for little comment. In Chapter v it is argued that the phenomena of the pressure of light and the diffusion of matter by radiation compel us to reject the usual doctrine that the velocity of light in a vacuum is equal to the limiting velocity which can never be exceeded (that is, the c of the Lorentz formulae). Chapters vi–viii are described as an attempt to deal with gravitation on the basis of Minkowski's work. Planetary motion is treated by combining the Newtonian law of attraction with the FitzGerald contraction. The displacement of the Fraunhofer lines is deduced from the assumption that the time-rate of the 'solar chronometer' corresponds to that of an imaginary planet just skimming the sun's surface. This assumption gives half of Einstein's result. All that is claimed for this treatment of gravitation is that it gives results of the right kind and the right order of magnitude without making use of more than the most elementary algebraic expressions. It is acknowledged that space and time are dealt with separately, instead of together, and that the exposition lacks finality.

Chapters ix and x discuss some difficulties concerning the propagation of gravitation and the irregularities in the earth's rotation. In Chapter xii, the author disagrees with Einstein's principle of equivalence, which is considered as difficult to reconcile with the relativity theory of gravitation. It is suggested that the principle should be regarded as "no more than a scaffolding or temporary support, made use of by Einstein in the erection of his edifice, ultimately to be discarded". Chapters xi and xiii attack the theories of the expansion of the universe and general space-curvature. It is pointed out that

the apparent regression of the nebulae may be interpreted as a progressive diminution in the velocity of light. The author considers that "in the present state of knowledge he can find no reason or even excuse for postulating spherical space or any other of the imaginary forms proposed". Those who do so "are like those who in past times spent no less ingenuity in devising mechanical models of a hypothetical all-pervading medium which according to present-day philosophy has no existence". . . . "It may be that some day we shall wake, as from a dream, to find that things are not so different from what they seem after all."

The book concludes with twelve appendixes and an index. H. T. H. P.

Systematic Zoology

Dr. H. G. Bronns Klassen und Ordnungen des Tier-Reich wissenschaftlich dargestellt in Wort und Bild

(1) Band 5: Arthropoda. Abt. 4: Arachnoidea und kleinere ihnen nahegestellte Arthropodengruppen. Buch 4: Solifuga, Palpigrada. Bearbeitet von C. Fr. Roewer. Lief. 1. Pp. 160. Lief. 2. Pp. 161–320. Lief. 3. Pp. 321–480. Lief. 4. Pp. 481–608. Lief. 5 (Schlusslieferung des 4 Buches). Pp. iv+609–725. Lief. 1–5, 76 40 gold marks.

(2) Band 4: Vermes. Abt. 2: Aschelminthen. Buch 1: Rotatorien, Gastrotrichen und Kinorhynchen. Bearbeitet von A. Remane. Lief. 2 (Rotatorien). Pp. 161–288. 16.80 gold marks. Lief. 3 (Rotatorien). Pp. 289–448. 18.80 gold marks. Lief. 4 (Rotatorien). Pp. 449–576. 16.80 gold marks.

(3) Band 3: Mollusca. Abt. 3: Bivalvia. Bearbeitet von F. Haas. Lief. 4. Pp. 385–544 und Nachtrag zum Schriftenverzeichnis. 23 gold marks.

(4) Band 3: Mollusca (Weichtiere). Abt. 2: Gastropoda. Buch 3: Opisthobranchia. Bearbeitet von H. Hoffmann. Lief. 1. Pp. 152. 18.80 gold marks.

(Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932–1934.)

(1) IN a monograph of 637 pages Prof. C. Fr. Roewer has assembled the information available in the literature on the Solifuga and has revised and extended this in the light of his observations on more than 2,500 specimens. The diagnosis of the order, a very brief history and a list of nearly 400 papers on Solifuga precede the account of the organisation, in which the external features are described in great detail, including the remarkable organs termed malleoli, situated on the coxa and the two proximal trochanters of the fourth leg, the function of which is still undetermined. The description of the internal organs occupies about fifty pages and is followed by a short account of the embryonic and post-embryonic development and by an interesting chapter of fifteen pages on the biology of Solifuga.

More than half the work (350 pp.) is devoted to the systematics of the order, which is subdivided into ten families and 138 genera, many of which are new. The distribution of the families is shown on a series of outline maps. A discussion of the phylogeny concludes by quoting Kästner's summary that, if the ancestral arachnid were *Limulus*-like, the scorpion is the oldest arachnid, but if the arachnids arose in the Tracheata the Solifuga must be regarded as the most primitive. A diagram is given showing the relations of the families to the Rhagodidae—regarded as the most primitive family.

The order Palpigrada, the first representative of which was discovered by Grassi fifty years ago, contains small, even minute, forms which vary in length from 0·8 mm. to 2·8 mm. The bibliography on this order consists of only about thirty papers. The external characters and the internal anatomy, of which the principal features are fairly well known, are described, but the embryonic development has not been investigated and little is known of the post-embryonic growth. The food is believed to consist of the contents of the eggs of *Japyx*, *Campodea* and *Pauropus*. The order has only the one family (Kœneniidae) established by Grassi, which contains four genera and twenty species. The Palpigrada are regarded as standing with the Solifuga, at the base of the arachnid stem, and the former present a greater number of archaic characters.

The volume has a general and a systematic index, and is well provided with dichotomous keys and with illustrations in line to demonstrate the principal systematic and structural features.

(2) These three parts on the Rotifera conform in method of treatment and in excellence of illustration to the high standard of the first part (see NATURE, 129, 743; 1932). In the present parts the account of the anatomy of rotifers is completed

and particular attention may be directed to the sections on the alimentary canal including the mastax, on the muscles, with some useful schematic figures, on the protonephridia and on the reproductive organs. The development is carefully considered. The classification used is a modification of that proposed in 1899 by Wesenberg-Lund; there are three orders—Seisonidea, Bdelloidea and Monogononta, the last of which is divided into three suborders—Ploima, Flosculariacea and Collothecacea. The systematic consideration of the genera follows. We look forward to the completion of this well-balanced account of an unusually interesting group of animals.

(3) The fourth part of the work on the Bivalvia is devoted to the further consideration of the shell and of pearls. The methods for distinguishing ordinary and culture pearls are described; for example, by examination under different forms of illumination and in a magnetic field, by their specific gravities and by investigation of the nucleus after boring halfway through the pearl. An interesting historical account of the culture of pearls follows. The author then proceeds to the description of the changes of the form of the shell during growth, the effect of the three-dimensional growth on the closing mechanism and the influence of varying conditions on shell-form, that is, the plasticity of the shell. A useful account is given of the variations in dimensions, weight, sculpture and periostracum of the shell and of the convergence in shell-form in different genera; for example, the shell-form characteristic of *Mytilus* is found in other genera, as in certain *Tridacna* and in *Driessena*. The work concludes with an additional list of nearly 900 titles of works on bivalves.

(4) The first part of the new volume on Opisthobranchia, with the exception of a definition, a concise statement of the principal external and internal features and an outline of the classification, is devoted to a bibliography extending to 150 pages and containing references to more than 3,000 works on this order of molluscs.

Gaza

Ancient Gaza, 4: Tell el Ajjūl

By Sir Flinders Petrie. Pp. vii+21+70 plates. (London: British School of Archæology in Egypt; Bernard Quaritch, Ltd., 1934.) 50*s*.

IN this volume Sir Flinders Petrie, following his usual and admirable practice of publishing the report on his work in the field with a minimum of delay, has given subscribers to the British School of Archæology in Egypt and archæologists in general a fully illustrated account of the material obtained by the expedition to Gaza (Tell el Ajjūl) in 1933–34. This season, the fourth spent on that site, was devoted to clearing about five acres of the Tell down to native rock, further work on the cemetery, and to drawing objects and preparing plans.

The area selected for excavation presented unexpected difficulties. Not only was it found to have suffered much from denudation, but also it had been used as a cemetery in the Hyksos period and for later burials. Further, the old land surface had been deeply cut by denudation before settlement began. Dating proved a complex matter, and so shallow were the deposits and in such separate patches that no continuity of stratification could be fixed. Dating by pottery, therefore, had to serve in linking up the area with palace levels. The most continuous course of stone basing of the walls is to be accepted as "representing the kind of civilization acquired during the xvth dynasty rule in Egypt".

What is perhaps the most remarkable feature of the season's results is the quantity of jewellery—gold, silver or electrum—recovered, not only in graves, but also in three hoards, evidently from their character old metal intended for melting up, which reflects the wanderings of a Syrian metal trader.

Two hundred and twenty weights were recorded, of which one third were surface finds. These bring the total of weights found at Gaza up to 448. The standards represented are Palestine, Babylonia, the West, Egypt, Syria, Persia, Phœnicia and an international gold beqa. The percentages of the standards indicate that Syria, with Persia and Babylonia, were far more influential in trade than Egypt. The small size of the weights is also remarkable.

Sir Flinders concludes his report with some general reflections evoked by the conclusion of his activities at Ajjūl owing to the change in the conditions of excavation imposed by the Antiquities Department. In consequence, the work of the School has now been transferred to Syria. In summarising the work that has been accomplished in eight seasons, he points out that these years have been more fruitful for the history of Egypt than any he has spent in the field, with the exception of those of the Naqada and Badari discoveries. Two dark ages of Egypt have been

explained by the invasion of people from the Caspian basin—the highly developed rock-workers of the seventh and eighth dynasties and the rude horsemen of the fifteenth and sixteenth dynasties. In the history of Palestine, instead of vague bronze and iron ages, dating has now been stabilised by scales of Egyptian dating and earlier sequence dates.

Further, it is pointed out, Gaza has revealed the more advanced work of a higher civilisation which was imported from foreign lands lying to the north. It has now become one of the problems of archæology in the Nearer East to investigate this unknown civilisation. The jewellery, of forms without parallel, imported to Gaza before 2000 B.C., invites further research. So Sir Flinders with indomitable spirit takes up the challenge and transfers his activities to Syria in the hope that he may be the pioneer in discovery here, as he has been elsewhere, and bring to light the origin of these previously unknown forms in what, he hopes, may prove to be the greatest culture of those ages.

Progress in Enzyme Study

Ergebnisse der Enzymforschung
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 4. Pp. xii+391. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 31 gold marks.

THE subjects chosen for critical discussion in this, the fourth annual issue of 'enzyme progress', relate to more difficult and obscure sections of the field: it is perhaps all the more valuable to have them monographed.

As before, the contributors are from laboratories in many countries, and the contributions in three languages. T. Bersin of Marburg writes on thio-compounds and enzymes, to which attention has been particularly directed as the result of the work on the tripeptide, glutathione, which has the grouping $-CH_2SH$ in a side-chain, and takes part in a reversible biological oxidation-reduction system. There is evidence that the ferment papain is only active when it contains an SH group, and the same is true of urease. The relation of glutathione to the activity of several other enzymes is discussed.

That activation and inhibition of certain enzymes is brought about by definite chemical compounds is well known. In particular, activity is affected by hydrogen ion concentration; oxidation-reduction potentials also seem to play a part. The existing knowledge of this subject for a number of specific enzymes is summarised by H. Tauber of New York.

The discussion as to the intermediate stages during the biological degradation of sugar is continued by O. Meyerhof of Heidelberg in regard to the formation both of lactic acid and alcohol respectively as end products. In both cases, sugar phosphoric acids appear in the early stages: the scheme of Embden seems to be finding general acceptance.

Information of a more exact character is accumulating in regard to the fermentation of the sugars by various bacteria which leads, in certain examples, to such products as propionic or butyric acids, to butyl alcohol or to methane. This section is written by A. J. Kluyver of Delft, who has managed to condense a good deal of information into some forty pages.

Somewhat novel is a contribution from Hungary by Bodmár and Barta on the enzymes of the tobacco leaf and the biochemical changes during the drying and fermentation of tobacco. This is essentially an operation which should be under biochemical control, and its fuller understanding will undoubtedly be of interest to what is largely an empirical industry.

A second section of industrial application is that by Albert Hesse of Munich on enzymes in the bakery, in which the newer work is elaborated. The differences in the wheat flours of the various countries and the variations in the national requirements in regard to the nature of the loaf make international comparisons and deductions in this subject impossible. Baking is another example of an industry which is still largely empirical, and so has much to learn from biochemical science.

The only section in French is by Maurice Beau of Paris; it deals with rennet and the coagulation of milk. Considering its importance, milk has been much neglected by the biochemist, and there is all to learn about its proteins and minor components. The work is, of course, of extreme difficulty both experimentally and in regard to its interpretation. One phase of it, that of lactoflavin—which is possibly vitamin B_2—is elaborated here by Wagner-Jauregg of Heidelberg, who has been associated with Kuhn in much of his most brilliant work in this subject. This has enabled both the determination of the constitution of

lactoflavin and the synthesis of what is probably a stereoisomeric colouring matter from *l*-arabinose.

The final section, contributed from Princeton by E. Newton Harvey, deals with a novel subject, namely luciferase, which is an enzyme concerned in the luminescence of living organisms.

The editors and authors are once more to be congratulated on the production of a volume which will be found both stimulating and helpful to all workers in these particular fields of inquiry.

E. F. A.

An Introduction to Structural Theory and Design: Theory

By Prof. H. Sutherland and Prof. H. L. Bowman. Second edition. Pp. xi+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17*s*. 6*d*. net.

SINCE its original publication about five years ago, this work has proved itself a very valuable introduction to the basic conceptions and principles of structural theory as related to trusses, rigid frames and space frameworks, and has asserted itself as a trustworthy book of reference. In preparing the second edition, the authors have taken this opportunity to effect some revision, particularly in enlarging the section on moment distribution and in adding one on the column analogy for rigid frame analysis.

On the whole, however, the book follows the same lines as its predecessor in treating, very conscientiously and with a wise insistence on the value of simple proofs and direct solutions, the stress analysis of the wide range of structures included in its purview. It is particularly rich in the explanations given of the numerous direct and indirect methods of analysis which are available and, while its purpose is to interpret as fully as possible the introductory theory of structures, this is illustrated by numerous worked examples showing how, in practice, the actual processes, be they graphical or analytical, are carried out. With the many further problems suggested for analysis, the work could be used to great advantage for class or private study. At the same time, the clear-cut subdivision of the matter, the finality with which each method is treated and the practical outlook of the authors make it within its limits an eminently useful book for those professionally engaged in structural work.

J. A. C.

Electrical Water Heating: with Special Reference to the Domestic Storage Heater

By D. J. Bolton, Philip C. Honey and N. S. Richardson. Pp. viii+192. (London: Chapman and Hall, Ltd., 1935.) 7*s*. 6*d*. net.

THIS book deals with both the scientific and the commercial aspects of electrical water heating. It naturally falls into three main divisions: the first one is concerned with the construction of domestic storage heaters of various types, and the method of fixing and fitting them in the house; the second with the hot water systems at present in ordinary domestic use; and the last with the supply and consumption of electricity commercially.

There is a good description of the control of the temperature of electric heaters by the bi-metallic type of thermostat. In this, the differential expansion of invar and brass is employed to give the necessary change of length, and the method of enclosing such thermo-regulators in the cylindrical water-storage tanks is discussed in considerable detail. Various methods of grafting such an electrical system on to the existing hot-water circuit of the house are also included, and the several factors which affect the price of electricity as sold to the consumer are set out clearly. This book should prove of service to electrical engineers who are concerned with the problem of water heating, as well as to architects who are preparing to design the houses of the future.

Die Harze:

die botanischen und chemischen Grundlagen unserer Kenntnisse uber die Bildung, die Entwicklung und die Zusammensetzung der pflanzlichen Exkrete. Bearbeitet von A. Tschirch und Erich Stock. Dritte umgearbeitete Auflage von A. Tschirch: Die Harze und die Harzbehälter, Band 2, Halfte 1. Pp. xii+471. (Berlin: Gebrüder Borntraeger, 1935.) 48 gold marks.

WE have already noticed (March 31, 1934, p. 478) the first portion of this monumental work, which dealt in general with the resins. There has now been issued the first half of the special part describing in detail the individual resins. Those chosen are classified as the ester or benzoic resins, commonly termed balsams, and the bitter resins such as myrrh, elemi, etc. The information, covering a very great deal besides botany and chemistry, is of the fullest, and there are copious illustrations, both botanical and otherwise, including pictures of the original packages in which the resins are shipped as well as maps. We know of no other similar subject which has been monographed so exhaustively.

Der Chemie-Ingenieur:

ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob. Generalregister für Band 1–2. Pp. ii+99. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 8.80 gold marks.

THIS small volume, which is uniform in type and binding with the eight parts of "Der Chemie Ingenieur", consists of a general classification of the subjects treated in these books and provides a rapid means of discovering in which part a particular detail of the general subject is discussed. It thus prevents one having to examine the tables of contents at the end of each part until that part in which is the particular section of the subject required is found. The general index will therefore greatly facilitate reference to the contents of these eight books, and the authors are to be congratulated on completing their labours in such a thorough manner.

Polymerisation and Condensation Reactions

AT the meeting of the Faraday Society held on September 26–28 at Cambridge under the presidency of Mr. W. Rintoul, the subject of polymerisation and condensation reactions was discussed.

The technical development of the manufacture of the group of substances known as plastics, resins and moulding powders is now attaining large dimensions, and it occurred to the Colloid Committee of the Faraday Society that academic interest in these substances might be stimulated by such a meeting. In this it was not mistaken. Whilst the Faraday discussions have always been somewhat international in character, this meeting was favoured by the attendance of an unusual number of both members and visitors who came from overseas.

We are indebted in the first instance to Staudinger for emphasising the now generally accepted view that the polymers and condensates must be regarded as constituted of macromolecules formed by the polymerisation or condensation of single units. Both the physical and chemical properties of the finished materials should be capable of interpretation on this basis.

We now recognise three different types of macromolecules: the linear, which can be written $A(A)_nA$ or $(AB)_n$; the large ring or closed type; and the cross-linked variety. This latter in its simplest form might be regarded as a system of linear macromolecules linked together by cross-linkages like the rungs on a ladder, and in its most complex state as a crystal like silica.

Amongst a number of important and interesting topics three attracted most attention: the mechanism of growth of the large molecules from the small ones; the information yielded by X-ray examination of the substances, especially when stressed; and the relationship between the mechanical and physical properties on one hand, and on the other the chemical structure of the material.

The discussion made it clear that there must be a number of different mechanisms by which macromolecules can be formed. For example, in the formation of a macromolecular ester from a dibasic acid and a dihydric alcohol, the chemical reaction involved, namely, the esterification process, would appear to be energetically identical both for commencing and for propagation of the chain. On the other hand, in the polymerisation of a substance like styrene, the energetics of commencement and propagation are widely different. Once the growth has been initiated by the formation of what may be termed, to borrow from the nomenclature of chain reactions, a reaction centre, the chain propagation proceeds relatively rapidly.

During the course of the meeting, it became clear that a number of new factors not operative in the ordinary gaseous chain reaction must be considered in the growth of the macromolecule. For example, it is evident that in different systems the length of the macromolecule is subject to wide variation. In the case of many olefine polymerisation processes the mean length of the macromolecule corresponds to the dimer; in the case of the acrylic acid the length can certainly exceed ten thousand of the monomeric units. At present, it is difficult to elucidate the reason for this wide variation in chain length. It seems possible, at least in the olefines, that ring closure to form a cyclic compound, which can, of course, open again, plays an important part in retarding the growth of the chain. In the drying oils a steric factor appears to be important; the polymer must thus be regarded in its undistorted form as spherical rather than thread-like. Both in the polymerisation of acetylene and in the case of formaldehyde, it seems certain that chain termination is brought about by a special type of collision of the growing end of the chain with a monomer, the terminating collision differing from the propagating collision both in the energy and the number of degrees of freedom involved.

One interesting feature of many of these reactions is the relatively rapid growth of the chain after initiation. It seems unlikely that this can take place through the ordinary collision mechanism, for the rate of diffusion of the monomer to the active centre at the end of the growing chain would then govern the reaction velocity; the energy of activation of the controlling process is known to be low, of the order of 5 kgm. cal. The suggestion was advanced that monomeric molecules might be supplied to the growing end of the chain by travelling along the chain. On this view, the process of chain growth must be regarded as analogous to the growth of crystals such as hydroquinone, where diffusion over the crystal surface plays a large part in controlling the rate of reaction.

Finally, it is well known that a macromolecule such as polystyrene can be decomposed into simple units by heat, and indeed at relatively low temperatures; the same appears to be true for

the polymeric forms of formaldehyde, but many similar polymers are not so readily reversibly decomposed and require really high temperatures to bring about thermal destruction, from the products of which the monomer can be isolated. It is significant in this connexion that the pyrolysis of straight chain hydrocarbons proceeds more readily the longer the chain.

The chain-like structure of the cellobiose polymer cellulose and the more complicated polypeptide chain found in the proteins has been confirmed in a satisfactory manner by X-ray examination. These systems are, of course, quite distinct from the ordinary crystal in that the series of parallel chains along which the composition and structure are subject to repetition are usually so long that it is impossible to identify the relatively small elementary cell as determined by X-ray examination with a definite number of macromolecules. The molecules are much longer than the elementary cell and the X-ray pattern obtained is a fibre diagram.

A number of polymers like the polyoxymethylenes exhibit a crystalline pattern; others like the phenol formaldehyde complexes only give an amorphous pattern; whilst a third and most interesting group give an amorphous pattern in their natural state but a crystalline pattern when stretched, these including rubber, polyvinyl alcohol, sulphur and polyethylene tetrasulphide. All these substances when stretched exhibit over a suitable range of temperature the remarkable extensibility shown by natural rubber. It is difficult to avoid the conclusion that great extensibility is associated with very long macromolecules, which are sufficiently flexible and at the same time mobile under stress to permit of orientation in parallel threads by the simple application of tension.

There are obvious difficulties to be overcome if this simple hypothesis be accepted as correct. On stretching rubber and freezing it, its fibre diagram and extension are both preserved; on warming, both extension and fibre diagram disappear, a process analogous to the melting of a solid. In a collection of small rod-shaped molecules in the liquid form, thermal agitation will ensure that the molecules are in complete disorder; but as the molecules grow longer the Van der Waals' forces of cohesion increase and the tendency for bundles or clusters of molecules to be formed with a common axis of orientation increases, a phenomenon termed cybotaxis. We might have anticipated unstretched rubber to be a cybotactic fluid *par excellence*. It is possible that this is really the case, but that the microclusters which are themselves in disorder are too small to be revealed by the X-rays. The thermal changes associated with the stretching of rubber give us a measure of the heat of adsorption of the polyprene chains on a polyprene surface.

The most important property of macromolecular polymers is that they alone amongst organic materials manifest to a significant degree such mechanical properties as strength, elasticity, toughness, pliability and hardness. Well oriented and fibrous polymers such as natural cellulose and silk are, weight for weight, stronger than iron. Synthetic polymers are not so strong as these natural products, and a good deal of attention has naturally been devoted to the problem of calculating the maximum tensile strength possible in a polymeric material and the cause of the relatively low values obtained. The following figures for the tensile strength in kgm. mm.$^{-2}$ for various materials at 20° C. are interesting:

Best spring steel	197	Iron	20
Flax	100	Glass	5
Rubber	80	Polystyrene	4
Silk	35	Urea formaldehyde	3
Wool	28	Asphalt	1×10^{-2}
Artificial silk	25		

Calculations from the form of the Morse potential curve show that a tensile strength of no less than 2,000 kgm./mm.^{2} would be obtained for a completely orientated and fibrous rod composed of a bundle of macromolecules the individual lengths of which are equal to that of the rod. There seems little reason to doubt that materials stronger than the best steel should be capable of being made.

Another interesting property peculiar to these polymers is their extensibility or swelling in various solvents. Linear or chain-like polymers may be prepared which undergo simple solution in appropriate solvents.

As the chain length of the macromolecules increases, the process of molecular solution commences due to solvent imbition and swelling of the solid; this is followed by the formation of aggregates or micelles. These micelles are eventually dispersed to the molecular form on further appropriate dilution of the solution. On the other hand, cross-linked polymers such as silica or vulcanised rubber or phenol formaldehyde resins do not swell or disperse in solvents.

Staudinger has prepared a most interesting series of products from polystyrene, exhibiting all the transition stages. Polystyrene consists of simple thread-like macromolecules which will go into true solution in organic solvents; the process of solution as we have noted being preceded by solvent imbition and swelling. If, however, to the styrene a small quantity of *p*-divinylbenzene be added before polymerisation, then when the chains are formed molecules of this material are incorporated in the growing chain and cross-

linkages come into existence by the formation of divinylbenzene bridges. Such a cross-linked system is no longer dispersible in solvents, although if not too many cross-linkages are formed the material is capable of swelling. If the ratio of styrene to divinylbenzene is as high as 50,000 to 1, the product is highly extensible but insoluble, whilst if it be as low as 1,000 to 1 the product shows scarcely any sign of swelling at all.

It is clear that the properties of the polymers and condensation products may be altered to a most extraordinary extent by the addition of suitable materials even in subanalytical amounts.

ERIC K. RIDEAL.

Maintenance of Life in Isolated Animal Organs

THE preliminary announcement of the work of Carrel and Lindberg on the maintenance of life in isolated organs, to which reference has already been made in our columns[1], can now be amplified with further details of their method, from which an idea can be obtained of how the difficulties involved have been surmounted[2]. The organs are removed with complete aseptic and antiseptic precautions from an animal that has just been killed by bleeding under anæsthesia; adult cats or fowls are generally used. With the organ are removed the surrounding tissues, arteries, veins, nerves and lymph vessels: for example, in the case of the ovary, with the organ itself are removed the Fallopian tube, and a flap of peritoneum and connective tissue containing the ovarian artery. During the operation the abdominal cavity and the organ are protected with gauze pads soaked in Dakin's solution.

The organ is introduced into the culture chamber protected by a sheet of 'cellophane' and the artery is connected with the cannula of the apparatus; the chamber is closed by a rubber stopper and sealed with a cellulose acetate cement. A sterile pulsating circulation is maintained through the organ by the apparatus; different culture media have been used for this purpose. In order that the supply of glucose and bicarbonate may be sufficient for several days, the volume of the medium must be about 2,000 times greater than that of the tissues. For example, a cat's thyroid which weighs 85–110 mgm. requires about 230 c.c. of fluid. The apparatus may be used with 200–900 c.c. of medium. The latter may be blood-serum, diluted with Tyrode's solution, and containing sometimes hæmoglobin, or an artificial growth-activating solution, containing protein-split products, hæmin, cysteine, insulin, thyroxine, glutathione, vitamins A and C, blood-serum, etc. A small amount of phenol red must be added, as indicator of the metabolic activity of the organ, as well as of the occurrence of bacterial infection. The medium is under an atmosphere of 40 per cent oxygen and 3–4 per cent carbon dioxide, the remainder being nitrogen, and is kept well aerated.

The apparatus is kept in an incubator at 37°–38° C. and is so designed that the organ and perfusion fluid can be continuously observed. The circulation is started about an hour after the death of the animal; the number of pulsations is usually about 60 per minute, the systolic pressure being 120 mm. mercury and the diastolic 60 mm. mercury. Rate and pressure can be varied at will.

The organs used in the apparatus so far have been the thyroid gland, the ovary, the suprarenal gland, the spleen, heart and kidney. In the case of the thyroid, three different media have been used as perfusion fluids; with diluted serum or an artificial medium containing amino-acids, the volume of the gland decreased and the follicles remained full of colloid, even after twenty-one days. With the medium containing peptones the glands grew and doubled their weight in three to four days; the consumption of sugar was increased more than three times. Histologically, there were observed either a disordered epithelial proliferation with disappearance of the colloid or an increase in the volume of the cells and in the number of follicles, with production of colloid. In an experiment with an ovary perfused with a growth-promoting medium, the weight of the organ increased from 90 mgm. to 284 mgm. in five days and three corpora lutea developed. Growth was, however, accompanied by disorganisation; there was a luxuriant and disordered proliferation of the stroma and of the epithelial cells.

These experiments show that an entire organ can be kept alive *in vitro*, increasing in size and weight, due to the appearance of new cells and tissues. The method should have great value in the study of different organs, especially those having an 'internal secretion', and further reports by Carrel and Lindberg will be awaited with interest. If it is permissible to speculate about the future, will it be possible for the chemist to utilise isolated perfused organs for the manufacture of their specific secretions in unlimited quantities, in cases in which a chemical synthesis is difficult or has not yet been achieved?

[1] NATURE, 135, 1066; 1935.
[2] *Science*, 621, June 21, 1935. *C.R. Acad Sci.*, 14, July 1, 1935.

Recent Antarctic Research

undertaken by the Discovery Committee

THE R.R.S. *Discovery II*, 1933-35

By Dr. N. A. Mackintosh

THE R.R.S. *Discovery II* returned to England at the end of her third commission in June this year. During the twenty months she was away, her work included an examination of the whale population and its environment in the vicinity of the Atlantic and Pacific ice edge; repeated observations on a particular meridian for the study of seasonal variations; some repetition and consolidation of observations taken in previous commissions; a survey of the South Shetland Islands and, on the homeward voyage, a new line of stations running parallel to the East African coast from Marion Island in 47° S. to the Gulf of Aden. Throughout the commission, routine soundings were taken with the echo-sounding machines. The route taken by the ship on her various cruises is indicated in Fig. 1.

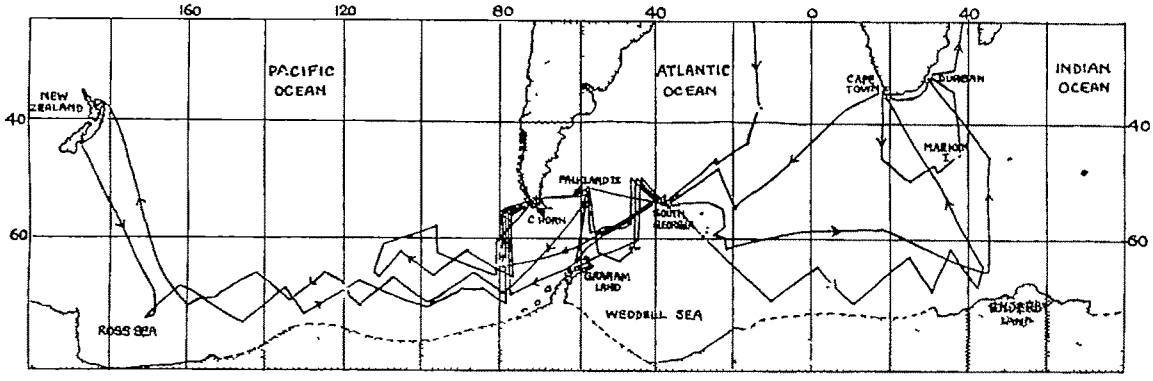

FIG. 1. Voyages of the R.R.S. *Discovery II*, 1933-35

Several years will, of course, be required for a proper examination of the material and data collected, but certain interesting points have already arisen and may be briefly described here.

During several long cruises, in which a zigzag course was followed to the north of the pack ice, direct and continuous observations on whales were combined with routine observations on plankton and hydrology. These observations provide material for comparing the abundance of whales in the Pacific and Atlantic sectors of the Antarctic, and an important correlation has been observed between the distribution of whales and the surface temperature of the water. It is anticipated that the most important results of the commission's work will in due course be derived from these cruises off the ice edge.

The section of the work which may be said to have yielded the quickest results was that in which a line of stations on the meridian of 80° W. was repeated in December, March, September, October and November. Each line included from seven to ten stations at intervals of about 90 miles, and in each case the southernmost station was at the edge of the pack ice. The routine at each station included a series of six vertical hauls with closing 70-cm. plankton nets from various depths between 1,000 metres and the surface. A preliminary examination of the samples from these nets reveals a large-scale migration of the plankton which is likely to be of far-reaching importance.

It is known that in the Antarctic zone there is a thin layer of cold Antarctic surface water which moves with a northerly component away from the ice. Below this is the so-called warm deep water flowing south, and below this again the cold Antarctic bottom water which moves northwards. Fig. 2 shows six vertical sections of the line in 80° W. The first shows diagrammatically the circulation of the surface water and the warm deep water. The other five show the newly ascertained distribution of the copepod *Rhincalanus gigas* in the various months in which the line was repeated. They are drawn quite roughly and may need adjustment when the material is examined in more detail. In December (summer) the species is mainly concentrated near the surface. In March it tends to sink to the north of the Antarctic convergence. In September (winter) it is practically confined to the warm deep water, and in October and November (spring) it has largely regained the Antarctic surface water. Similar seasonal changes in level have been

observed in several other species which, together with *R. gigas*, make up the bulk of the Antarctic macroplankton, but these do not appear to include the Crustacean, *Euphausia superba*, which constitutes the food of the Blue and Fin whales. To those who have studied the plankton of the Southern Ocean, it has for long been a problem to understand how organisms drifting in the surface water are not all carried northward into warmer latitudes where they could not be expected to survive. The stations worked by the *Discovery II* in 80° W. have provided material

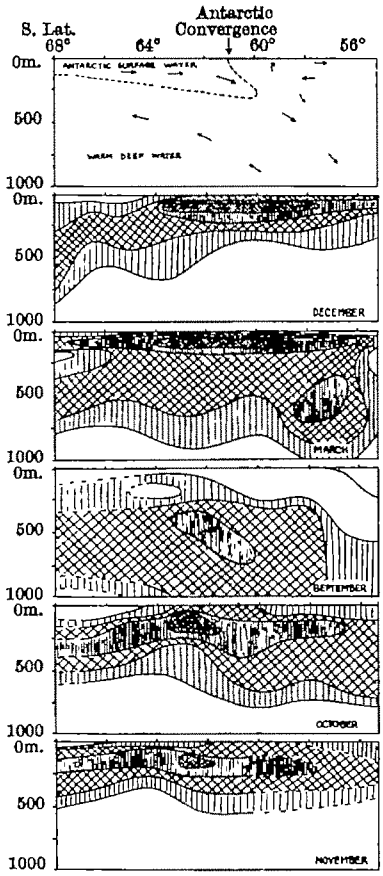

FIG. 2. Seasonal changes in the vertical distribution of the Copepod *Rhincalanus gigas* on the meridian of 80° W.

from the consideration of which a very substantial contribution can be made towards the solution of this problem. It appears certain that at least a considerable number of the species are carried northwards in summer in the north-flowing surface water, and return south again in winter in the southgoing stream at depths of at least 400 m. It is believed that such a large-scale circulation of the plankton, extending over some hundreds of miles of latitude, has not hitherto been demonstrated in any part of the world.

Among the new devices which were successfully used during this commission mention may be made of the Harvey phytoplankton net and the echo-sounding recorder. The former is an apparatus designed by Mr. F. W. Harvey of Plymouth[1]. Samples of phytoplankton are treated with acetone, and the amount of chlorophyll extracted is measured by comparison with a series of colour standards. This method is a great improvement on any hitherto used for estimating the relative abundance of phytoplankton in different localities. The apparatus was used at almost every station throughout the commission. With the echo-sounding recorder, the echo from the sea floor, produced by the ordinary deep-sea hammer, is picked up by a microphone and automatically marked on a moving scroll of paper. On this the contour of the bottom is traced out as a continuous line. It is most effective in shallow water and in places where rapid changes in depth occur, and it was in continual use during the surveying of the South Shetland Islands.

Among oceanic soundings, perhaps the most interesting observations were those made in the South Sandwich Deep. Soundings of 7,000–8,000 metres had previously been obtained to the east and north-east of the South Sandwich Islands. It has now been shown that the deep extends considerably farther south in the form of a curious narrow cleft in the sea floor exceeding 7,000 metres in depth, and running parallel with the chain of islands and the bend of the Scotia arc.

On the long line of stations taken up the East African coast, the fullest hydrological observations were made. The vertical section of this line is most instructive, and throws much light on the major current systems of the Indian Ocean. Large closing nets fished in deep water on the same line produced abundant material of biological interest.

During this commission the ship was under the executive command of Lieut. A. L. Nelson, R.N.R.

[1] *J. Mar. Biol. Assoc.*, 9, 2, 761; 1934.

THE R.R.S. *William Scoresby*, 1934-35

By G. W. Rayner

The Discovery Committee's vessel, the R.R.S. *William Scoresby*, completed in May this year her fourth commission—a short one of seven months devoted entirely to the marking of whales on the whaling grounds in the Antarctic seas off Queen Mary Land, off Enderby Land and to the south of Bouvet Island. The ship sailed from London on October 16, 1934, and made a direct passage to Simonstown, where final preparations for the work in hand were completed. The ship's personnel, under the executive command of Lieut.-Comdr. C. R. U. Boothby, R.N.R., included an experienced Norwegian whale gunner, Capt. J. Endresen, who had charge of the manœuvring of the vessel whilst

hunting and marking whales. The pack ice was encountered on December 3 when seven days out from Cape Town. Whales had been found on December 1 and marking began on that date.

The R.R.S. *William Scoresby* is an oil-burning steam vessel, and arrangements had been made for supplies of fuel oil from the whaling factory ships operating in the neighbourhood. On reaching the pack ice the vessel turned eastwards along its edge, and a few days later ships of the whaling fleet were heard in wireless communication with each other. When fuel oil was required, the vessel was enabled to find the desired factory ship by wireless bearings. She went alongside the factory ships in the same manner as the catchers go alongside for fuel—that is, with a floating whale carcase between the two ships to act as a fender. This manœuvre was carried out, in the open ocean, on eight occasions.

At the beginning of the season, the majority of the whaling fleet was found to be operating in the neighbourhood of Queen Mary Land, and marking was carried out in this area until the middle of January. During this period, which was largely spent near the edge of the pack ice or inside it, the work was hampered by poor visibility, much snow and fog, but on several occasions when the weather was good, numbers of Humpback and Fin whales were met and marked. Half way through January, a return westwards to the whaling grounds of Enderby Land was made, again skirting the pack ice which was now lying considerably farther south. Off Enderby Land, work was carried on in the open ocean and the pack ice was not again encountered during the remainder of the season. From this time until almost the end of the season, the weather was good and both Blue and Fin whales were usually to be found, sometimes in large numbers. Fin whales are to be met with at this time of the year in bodies numbering as many as fifty to a hundred and, on occasions, two such bodies were found in the course of a single day. When this occurred it was possible to mark between forty and fifty in the long daylight hours.

One month was spent in the waters off Enderby Land, and in March the ship moved westwards to the south of Bouvet Island. In the middle of March course was laid for the Cape, which was reached on March 29 after 122 days at sea without sighting land of any kind. During this time between seven and eight hundred whales—Blue, Fin, Humpback and Sperm—had been marked.

When opportunity offered, during bad weather or dark hours, water and plankton samples were taken and, for a few days in February, when in wireless communication with the R.R.S. *Discovery II*, the *William Scoresby* was able to co-operate to a small extent in her programme of hydrographic and plankton research.

In the months of December and January of this season, whale-marking was also carried out in the waters around South Georgia by Mr. A. H. Laurie, and several hundred Fin and Blue whales were marked in this area.

A number of whales marked during this commission have already been captured by the whalers, and the marks, together with the required data, returned to the Discovery Committee. Marks from Blue, Fin and Humpback whales have thus been recovered after periods varying from a few hours to three and a half months; and the distances traversed range from a few miles to a thousand miles. The data thus obtained are extremely instructive in showing the trend of movement of the whale stock on these grounds during the course of the season, but more valuable results are to be expected from marks returned during next whaling season.

National Food Policy

BRITISH ASSOCIATION DISCUSSION ON ECONOMICS OF DIET

THE discussion on the economics of diet before Sections F and I (Economics and Physiology) at the recent Norwich meeting of the British Association, and the resolution on nutrition at the present assembly of the League of Nations has emphasised the interdependence of problems of public health, agriculture and economics. This interdependence has become evident in the last few years of trade depression when attempts, which are not very successful, are being made to deal with the problems of these subjects separately. It is now being realised that they must be considered together in the light of the international position.

The world economic crisis paralysed international trade in foodstuffs as well as in other commodities. But agricultural production cannot be cut down so quickly as industrial factory production. Consequently stores of foodstuffs accumulated and prices fell.

The first reaction was an attempt to control production, limit imports and regulate marketing

with the object of raising prices. It was thought that when wholesale prices of foodstuffs rose, the purchasing power of primary producers for industrial commodities would be increased and general prosperity would return with an all-round rise in prices.

A different view is that low prices for agricultural products are the result rather than the cause of trade depression. Under-consumption, due to low purchasing power of the people in the industrial centres where depression is worse than in agriculture, is a more potent factor than over-production. Hence raising prices by reducing production and regulating the markets will lead to a further lowering of consumption, with the 'glut' appearing at a still lower level of consumption, a still further restriction in trade, and in addition, an increase in malnutrition due to a worsening of the diet of the poorer classes of the community. Those who approach the problem from this angle wish to find a solution of our problems in increased consumption rather than in controlled production.

The crux of the difficulty is how to initiate the desired increased consumption. One of the speakers at the British Association suggested that a beginning should be made with food. The present Agricultural Marketing Boards should be replaced by public utility companies which would run the processing centres; for example, centralised slaughter-houses, bacon factories, wholesale milk depots, through which products must pass from the farm to the consumer. These Boards would buy from the farmer and sell to the distributing trade. The gulf between what the farmer would get and what the consumer is asked to pay would be bridged by a direct subsidy from the State, paid to these Boards.

There would be no control of retail prices, because the services of distribution vary so widely in different classes. But the Boards, either themselves or by arrangement with distributors, would make the staple foodstuffs available at a price within the reach of the poorest. They would be available without tickets and irrespective of class, to all who would be willing to collect food from the depots or shops, and so save the cost of distribution which, in the case of some foodstuffs, for example, milk, is about half the retail price.

With the subsidy and this saving in the cost of distribution for those who care to take advantage of it, a diet adequate for health would be within the reach of the poorest. It was suggested that the result would be a reduction in preventible disease which, within a reasonable time, would effect savings in the cost of public health services which would go far to offset the cost of subsidising increased consumption. In addition to ultimate savings arising from improvement in health, there would be an immediate saving in the cost of complicated public health measures such as free meals and cheap milk for school children, and the issue of dried milk free or at reduced prices at child welfare centres. These measures with their taint of pauperism would be no longer necessary.

The results of a preliminary inquiry seemed to indicate that there may be as many as twenty million of the population whose health would be improved by an increased consumption of the more expensive foodstuffs such as fruit, vegetables, milk and animal products, and an examination of family food budgets and family incomes showed that price was the limiting factor for the consumption of these. If consumption were increased to a level at which every member of the community had a diet adequate for health, there would be room for a considerable expansion of agriculture in Great Britain without decreasing imports.

To initiate a national food policy on these lines, however, requires a Government subsidy, and subsidies are unpopular. It is argued, however, that the subsidy, in addition to making agriculture remunerative, would irrigate the field of internal trade, stimulate industries, and flow back again to the Treasury in increased income tax and other receipts.

On the same day as the discussion at Norwich, twelve countries, including Great Britain, France and Italy, submitted to the Assembly of the League of Nations a resolution stating that "the relationship of nutrition to the health of the people has become a social and economic problem of widely accepted significance", and that "this subject has an important bearing on world agricultural problems". The League has approved an inquiry into the whole question.

The discussion at the British Association and at the League of Nations has aroused sufficient interest to ensure that there will be a fuller inquiry. It is probable that we may be working towards a national food policy into which both agriculture and public health interests can be fitted and reconciled. But as one of the speakers at the British Association urged, we need far more information than is available before a food policy can be elaborated. It is in the public interest that such an inquiry should be instituted to ascertain:

What is the amount of increased consumption required to provide an adequate diet for every member of the community?

To what extent can health be improved by increased consumption of certain foodstuffs?

What effect would increased consumption have on British agriculture and on trade ?

What economic and financial measures are required to initiate and promote increased consumption ?

There is obviously a wide field of inquiry in which different Government departments should co-operate. A halt should be called to planning according to preconceived theories. We need far more information than is available before any more marketing schemes affecting the food supply of the country are brought into being.

Obituary

Sir John McLennan, K.B.E., F.R.S.

THE great Exhibition, held in 1851, resulted in a large profit which was well invested, and the income has for many years been awarded as scholarships to research students. The results prove that it was one of the best investments ever made. John Cunningham McLennan, among many other men ultimately distinguished in science, received such an award, and it enabled him to join the Cavendish Laboratory at Cambridge from his home in Ontario after his graduation at the University of Toronto. Under the guidance of Sir J. J. Thomson, the Cavendish was enjoying a burst of discovery in connexion with the electron and the ionisation of gases. Young McLennan quickly caught fire, and on his return to Toronto as a demonstrator in physics, at the age of thirty-two, he published a paper in the *Transactions of the Royal Society* (195, 1899) in which he proved that the ionisation of gases due to electrons in motion was similar in type to that due to Rontgen rays or the radiations from uranium.

At the same time that Rutherford and H. L. Cooke at McGill were discovering the penetrating radiation, supposedly and mainly from the radioactive substances in the ground, McLennan and E. F. Burton were finding, independently, similar results at Toronto. The later expansion of this subject into cosmic radiation was not then suspected. McLennan also carried out many experiments on the 'natural ionisation' in closed vessels, tracing the effects to minute quantities of radioactive materials, such as polonium in the walls, or radon in the enclosed air. By exposing sealed ionisation electroscopes over the ice on Lake Ontario, he definitely proved that the penetrating radiation over land was greater than over water, and this showed that a large part of the penetrating radiation came from the radium which Lord Rayleigh proved to be widely distributed in small quantities throughout primary and secondary rocks and sediments.

With immense energy, McLennan worked with others to raise funds for building that great physical laboratory at the University of Toronto which now so happily bears his name. Moreover, he secured abundant equipment with excellent apparatus especially for spectroscopy. One of his early successes was the discovery of the single line spectra of zinc, cadmium and magnesium and the deduction of their ionisation potentials. This was a sequel to the work of Frank and Hertz, who had obtained the single line spectrum for mercury. Electrons projected with low voltages in a discharge tube will excite a single line, but at a higher critical voltage the usual many-lined spectra appear.

During the War, McLennan came to England and took an intensely active part in the research work of the Admiralty in connexion with the anti-submarine campaign. His view was that a professor was co-equal in rank with an admiral, and he reported directly to the First Sea Lord. Thus, in certain magnetic work, he insisted on the speedy isolation of a submarine in a dock at Portsmouth with a view to a magnetic survey and the determination of its magnetic moment, hitherto an unknown quantity. At the same time, he organised the extraction of helium from natural gases near Calgary, and obtained a considerable quantity intended for airships and balloons, but actually used after the War for experimental purposes. During the greater part of 1919 he was scientific adviser to the Admiralty.

After the War, McLennan returned to Toronto and continued with enthusiasm and success his work on spectroscopy, for which he was awarded a Royal Medal of the Royal Society in 1927, and the following year he had the honour of giving the Bakerian Lecture to the Society on "The Aurora and its Spectrum". The brilliancy of the aurora is shown by the spectroscope to be due to nitrogen, and the lower limit of the height of the discharge has been proved by Størmer to be about eighty miles above the earth's surface. On any clear night it had been proved by Lord Rayleigh, Vegard and others that there is also present in the spectrum a notable green line (5377) the cause of which gave rise to much controversy. In the Bakerian Lecture (*Proc. Roy. Soc.*, A, 120, 1928) McLennan described how he and G. M. Shrum had proved in the laboratory that the green line was due to *oxygen*, suitably mixed with argon, which when in a metastable state, as Frank had shown in similar cases, is capable of transferring its energy to a different type of gas.

McLennan next determined with characteristic energy to instal at Toronto a cryogenic laboratory capable of liquefying air, hydrogen and helium. In this difficult undertaking he received advice and plans from Onnes at Leyden and financial support from the National Research Council of Canada, and

the scheme was quickly brought to a successful issue, so that new avenues of research work were opened to his numerous students. The relations between supra-conductivity and magnetism both in elements and alloys were investigated, and such work is continuing under the able guidance of E. F. Burton, who succeeded McLennan on his retirement three years ago.

Prof. H. E. Armstrong wrote to *The Times* on October 12: "In McLennan we lost no mere scientific worker, but a man of the most admirable social gifts, indeed a man to fall in love with. It was a sight for the gods to see him beam with enthusiasm and joy, in his Royal Institution lecture, at his helium super-cooled ring in which the current put into it in Leyden in the afternoon continued to circulate. He had nursed it over from Holland by air."

In the *Proceedings of the Royal Society*, McLennan wrote more than fifty papers, in forty of which his research students collaborated. Perhaps it would not be invidious to name those who contributed two or more papers—D. S. Ainslie, H. J. C. Ireton, H. Grayson-Smith, A. B. McLay, A. R. McLeod, G. M. Shrum. All this work, carried out at high pressure, sometimes led to stress and strain, and McLennan was always impatient with fools—sometimes with others—and though he could not suffer them gladly, his kindly, friendly nature usually restored sunshine after storm. He was a man who thought, spoke, wrote and lectured very clearly, and he was insistent on essential things. He was of a composite nature, greatly preferring friendship, but quite ready for a fight, and he fought hard. In the autumn of life his character was gentler and more mellow, and he was spared its winter. To his many friends and students he showed, time and again, the most thoughtful, unwearying kindness. A great factor in his life was the wise help and comfort of his able and interesting wife Elsie Monro, eldest daughter of William Ramsay, of Bowland, Scotland. Her death, two years ago, left him rather a desolate man, although he wore a brave face.

Of his work in England since his retirement Lord Rutherford writes of McLennan authoritatively: "Largely through his influence, the Union Minière of Brussels generously lent 5 gm. of radium to make a thorough investigation of the effects of mass radiation on cancerous growths. A committee was formed to control this great experiment, presided over by the president of the Royal Society supported by the presidents of the Royal College of Physicians and Royal College of Surgeons, and representatives of the Medical Research Council and the Department of Scientific and Industrial Research. This work, which is still in progress, is being carried out at the Radium Institute. McLennan threw himself whole-heartedly into this new line of work, and personally supervised every detail of the scheme. He spent much of his time at the Institute, and characteristically established the friendliest relations not only with the staff but also with the patients under examination. His services to this investigation in radium beam therapy are indeed great, and his sudden removal is an irreparable loss. Warm-hearted and impulsive, his vitality, his boyish enthusiasm and transparent simplicity of nature, endeared him to all those who came closely into contact with him. His sudden end in the full tide of his activities is a great loss to science and humanity."

McLennan was born on April 14, 1867, and died of heart failure on his way from Paris to Calais on October 9, at the age of sixty-eight years. He received many and well-deserved honours. In 1924, he was president of the Royal Society of Canada and two years later was awarded the Flavelle Medal by that Society. He was elected a fellow of the Royal Society in 1915, and in the current year he received his knighthood.

A. S. EVE.

Prof. Henry Briggs, O.B.E.

PROF. HENRY BRIGGS, who died in London on August 26 at the age of fifty-two years, had become, after a distinguished career, an authority on many subjects related to the scientific side of coal-mining. As head of the Department of Mining at Heriot-Watt College and Hood professor of mining at the University of Edinburgh, his influence amongst all students of mining technology was widely felt. In particular, mining engineers looked to Prof. Briggs for advice and information, based on his own original researches, on mine ventilation, on surveying and on the nature of coal. Latterly, he had interested himself in the subject of the production of oil from coal and carbonaceous materials, and had been appointed chairman of the Oil from Coal Committee of the Scottish National Development Council. He was a member of many scientific and technical societies, a member of council of the Institution of Mining Engineers and a fellow of the Royal Society of Edinburgh.

Briggs received his early education at Bradford whence, with a National Scholarship, he went to the Royal School of Mines and obtained the associateship with honours. He received his practical training in mining at collieries in Yorkshire, Cumberland and Wales and, previous to his appointment (in 1919) to the chair of mining at Heriot-Watt College, was, successively, demonstrator at the Royal School of Mines (and research assistant to Sir Clement le Neve Foster) and lecturer in mining at the University of Birmingham. His earlier research work included studies of mine rescue apparatus, and he was the inventor of an oxygen-breathing apparatus; during the War he carried out a number of investigations for the Trench Warfare Committee.

All Briggs's work showed originality of outlook and clarity of thought, and all his writings, with which he took particular pains, were lucid and literary. He had a keen and somewhat mordant wit which rendered his participation in discussions of controversial subjects highly effective; albeit he was constructive in his criticism. The coal-mining industry will feel his loss.

R. V. WHEELER.

News and Views

Billingham Hydrogenation Plant

THE formal opening on October 15 by Mr. Ramsay MacDonald of the coal hydrogenation petrol plant of Imperial Chemical Industries, Ltd., at Billingham-on-Tees, marks the start of a completely new British industry. Reference to the present position of commercial hydrogenation of coal has already been made in these columns (NATURE, April 6, 1935, p. 538). The Billingham plant is the first in the world to make petrol on a commercial scale from bituminous coal. It was originally intended to produce 100,000 tons a year of petrol from coal. It was later decided to increase the capacity to 150,000 tons, the extra 50,000 tons to be made either from coal or creosote oil and low-temperature tar. The first section was ready in January, 1935. Creosote oil was used as the starting material, and the first petrol was made in February. The first coal unit was started in June, and the output is expected to reach the designed figure before the end of this year. The normal rate of production is 410 tons or 123,000 gallons of petrol a day. 40,000 tons of petrol have already been made, of which 27,000 tons have been shipped to the oil companies for distribution. The coal consumption is estimated as 4 tons of coal to 1 ton of petrol produced.

THE raw coal is cleaned to less than 2½ per cent of ash and is ground up with oil previously made in the process to make a 50 per cent coal-in-oil 'paste'. This is injected against the working pressure of 250 atmospheres and mixed with hydrogen. The mixture is heated up to reaction temperature, and liquefaction of coal takes place at 450° C. A small heavy oil fraction containing the unconverted coal (5 per cent by weight) and ash is treated for oil recovery, and the coke residue is used as a fuel. The major part of the coal is transformed into lighter oils which are vapourised, and are recovered on cooling the gaseous products leaving the converters. The crude oil so obtained is distilled into heavy oil, middle oil and petrol. Heavy oil is further hydrogenated, in plant exactly similar to that used for the hydrogenation of coal, to give middle oil and petrol. Middle oil resulting from these two steps is further hydrogenated in vapour phase converters, in which the vapourised light oil and hydrogen are passed over a solid catalyst. The crude vapour phase product is distilled, the residual middle oil being separated from petrol and treated again. The whole of the coal is thus transformed into a small solid consumable residue, gas and petrol. Creosote oil and low temperature tars, although they play no essential part in the main process of making oil from coal, are conveniently treated along with the coal. The final petrol, after a simple purification, is pumped to storage tanks beside the River Tees, from which it is shipped by steamers.

Mr. Ramsay MacDonald's Tribute

IN his opening address, Mr. Ramsay MacDonald said that a little more than a generation ago, oil was displacing coal as a source of power, and chemists began to wonder whether it was not possible to 'resurrect' coal. The German chemists were the pioneers and among them stands conspicuously the name of Dr. Bergius. In 1921 he explained his ideas to the Department of Scientific and Industrial Research, and in 1923, under his influence, experiments were begun by the Fuel Research Station. "At that time, fortunately for the chemical industry, Sir Alfred Mond was living. . . . This country does not yet know what debt it owes to Sir Alfred Mond's vision. The result then was that the Government gave a subsidy to enable the necessary research to be prosecuted." In 1927 the experiments were taken over by the Imperial Chemical Industries; that secured that they would be conducted on the scale, and with the expenditure, necessary for their success. As a result of these experiments, the Government again came in. On July 17, 1933, Mr. MacDonald announced in the House of Commons that the Government would guarantee a preference to all British-produced motor spirit; and in March 1934 Parliament passed the Hydrocarbon Production Act. "Few announcements have had such far-reaching results. The immediate effect was that Sir Harry McGowan, that man of vision and energy, announced that Imperial Chemical Industries would at once proceed to erect a plant, and we are here within a year and a half to open it."

Sir Harry McGowan's Reply

SIR HARRY MCGOWAN, on behalf of Imperial Chemical Industries, Ltd., thanked Mr. Ramsay MacDonald for his address. He said that the opening of the Billingham plant has brought to a practical commencement an enterprise which has engaged the attention of his firm for many years. "We began at Billingham in 1927 on a very small scale indeed. For two and a half years research continued on a moderate scale, and by then it was clear that to achieve success a bold expansion policy was essential. Notwithstanding the discouraging business conditions of 1930 and 1931, we launched in those years an extended programme of work at a heavy annual cost. . . . In the end we spent more than a million pounds on this research." During this period active encouragement was given by H.M. Government and interest was displayed in the work by the Fuel Research Board. Similar activities were proceeding abroad though from slightly different angles. The German I.G. was at work on brown coal, the Standard Oil Company of New Jersey was occupied with petroleum oil, and the Shell Group were not inactive. "In 1931 we effected with these three companies a pooling of all interests in the hydrogenation process,

including a provision for a complete exchange of information, which promoted a more rapid advance by bringing us into immediate touch with every development of major importance." The construction of this plant marks the culmination of eight years' work. "The chemists, engineers, metallurgists, draughtsmen, and workers may all be proud when they look at this plant. To name them is impossible, but without being invidious I desire to single out Mr. Kenneth Gordon, who has been in charge of the research work and construction of the plant, and also my colleague Colonel Pollitt, who was the inspiration of our earliest efforts."

Tercentenary of Wilhelm Schickard (1592–1635)

ON October 23, 1635, in the middle of the Thirty Years' War, Wilhelm Schickard, a famous German orientalist and astronomer, died of the plague at Tubingen. Schickard was born on April 22, 1592, at Herrenberg, Württemberg. He was educated for the church, and at an early age became known for his knowledge of Hebrew. At the age of twenty-seven years he was appointed to the chair of Hebrew at Tubingen, and in 1631 was made professor of astronomy. He was also an inspector of schools at Stuttgart. In some of his least-known books are to be found early observations on the aurora, an account of the comet of 1623 which caused considerable commotion on its appearance, and his views on the refraction of light and the theory of the rainbow. He was known to both Kepler and Gassendi, and the latter, after he had observed at Paris the transit of Mercury of 1631 predicted by Kepler, wrote to Schickard: "The crafty god had sought to deceive astronomers by passing over the sun a little earlier than was expected, and had drawn a veil of dark clouds over the earth in order to make his escape more effectual. But Apollo, acquainted with his knavish tricks from his infancy, would not allow him to pass altogether unnoticed. To be brief, I have been more fortunate than those hunters after Mercury who have sought the cunning god in the sun. I found him out, and saw him, where no one else had hitherto seen him." Gassendi, in another letter of the same year, gave an account to Schickard of his fruitless efforts to see the transit of Venus.

Work of the Meteorological Office

THE annual report of the Director of the Meteorological Office for the year ended March 31, 1935 (London: H.M. Stationery Office. 9*d*. net), records a further big increase in the amount of information supplied to the public and to aviators, in accordance with a tendency that has been much in evidence for several years. The Aviation Services, for example, report a total increase of 18,747 in inquiries and of 2,404 in weather reports passed to aircraft in flight; in the British Climatology Division 2,348 general or scientific inquiries were dealt with, this figure including 178 legal inquiries, representing nearly a sixfold increase as compared with 1924–25 and nearly a doubling of the volume of inquiries in the past five years. While the main work of the Meteorological Office during the year under review has been on the same lines as in previous years, certain changes of organisation have been completed. Since the reorganisation after the War, there have been separate divisions for forecasts and aviation, but as experience has shown that this arrangement is not the best from the point of view of efficiency, the two divisions have been combined since October 1, 1934, control of the single large division by a single head, with two senior officers as deputies, being aimed at eventually. The Naval Division has for years been working in co-operation with the Admiralty towards the creation of a weather forecasting service within the Fleet which shall be self-contained but not independent of the State Meteorological Service; that objective has been attained with the expectation of its being in full operation by the end of 1936. Other important changes include a restriction of the responsibility of the Meteorological Office in the matter of gale warnings to the issue of the warning telegrams, the Board of Trade being responsible, as from September 1, 1934, for the exhibition of the warnings and the supply and maintenance of warning cones for that purpose; and the taking over by the Ministry of Agriculture and Fisheries and the Fishery Board of Scotland of the supervision of the stations of the Fishery Barometer and Barograph Service as from January 1, 1935.

THE fusion of the two branches of the Meteorological Office formerly known as the Forecast and Aviation Divisions, referred to above, does not involve any radical change in the system of dealing with weather forecasts and reports in connexion with aviation. Nevertheless, there have been some developments of the existing system. Consequent upon the increased practice by pilots of following direct compass courses on flights from Great Britain to the Continent, it was found necessary to alter the position of auxiliary weather reporting stations formerly established to serve the old Continental air routes. This has led to the closing down of the auxiliary weather reporting stations at Farningham, Deal, North Foreland and Sandgate, and the opening of new stations at Leatherhead, Crowborough and Bexhill, and to an increase in the personnel of the meteorological station at Manston Aerodrome to make practicable the issue of reports throughout the twenty-four hours. Another development was the installation at Croydon Airport of a 'ceiling projector'. This is a searchlight arranged to send a powerful beam of light vertically upwards, which enables the height of low cloud over the airport to be measured at night. The measurements are made at the meteorological station itself, and cloud heights are supplied in response to requests from pilots flying at night. Stations newly established within the period under review included one at Abingdon to meet the requirements of Central Area Headquarters of the Royal Air Force, and another similar station at the new Royal Air Force station at Mildenhall (Suffolk). Both these stations have personnel capable of obtaining information about the state of the upper atmosphere and making forecasts. These additions brought the number of local forecasting centres in Great Britain up to twenty-five.

River Bank Protection

FOR the Inland Navigation Section of the Sixteenth International Congress of Navigation, Brussels, 1935, Dr. Brysson Cunningham prepared a report on "The Estuarial Embankments of the River Thames". Of the origins of these walls little is definitely known and, in his "History of the Port of London", Sir Joseph Broodbank inclines to the view that their construction was a gradual and piecemeal process undertaken locally with the purpose of reclaiming for agriculture the valuable lands along the banks of the river, and probably initiated by immigrants from Flanders familiar with work of this kind. As he also says, "The builders in carrying out their object would not trouble themselves as to the effect their work had on the stream nor did they realise that they were, in fact, performing a mighty service in providing for London one of its greatest assets as a Port". Records of repairs and alterations have been traced back to the time of Edward II, and about that time Commissions of Sewers—using the word in its original sense—began to be appointed to exercise jurisdiction in several localities. Until 1930, when the Land Drainage Act established Catchment and Drainage Boards to take over their duties, these Commissions acted under the authority of an Act of 1531 to protect the lands from being flooded either by inundation or accumulation of superfluous waters. As consultant engineer to two of these bodies entrusted with portions of the Thames Embankments, Dr. Brysson Cunningham was able to advise the Congress as to the nature of the problems presented, and gave an account of the construction, maintenance, repair and renewal of these walls. Altogether, the earthworks on both sides of the river below London Bridge have a total length of approximately 120 miles and give protection to 64 square miles of low-lying marshland. Being 4–5 feet above Ordnance Datum while H.W.O.S.T. level is 10–13 feet, these extensive lands would, without protection, become permanently flooded. In the report, the several inimical agencies are described and, by maps, sections and diagrams, the methods and materials used to ensure adequate defence are fully exhibited.

Research on Combustion

NO one is better qualified than Prof. W. A. Bone to give an account of "Fifty Years of Combustion Research"—the title of his William Young Memorial Lecture, delivered to the North British Association of Gas Managers on September 12. The account gives a readable and comprehensive story mainly of the work due to the late Prof. H. B. Dixon and his school, and not least of Prof. Bone himself and his pupils. The lecture included some of the more recent observations on the combustion of gases at very high initial pressures, with activation of nitrogen, the description of some of the curious phenomena such as the 'spin' of the flame head in the detonation wave—observations calling for remarkable achievements in high-speed photography. The existence recently observed of double ranges of ignition temperatures of gases with an intervening 'inert' zone of temperature emphasises the complexity of the process of ignition. The 'chain theory' which has been so extensively used to account for combustion phenomena is held to be not 'mere moonshine' but to merit critical reception when capable of being harmonised with experiment. Prof. Bone closes with the insistence on the necessity of perpetual experimentation, for as Priestley said, "Speculations without experiments have always been the bane of natural philosophy".

Chemical and Physical Society, University College

THE Chemical and Physical Society, now the senior Society of University College, London, opened its sixtieth session on October 15. Before a large and distinguished gathering Dr. Henry Forster Morley, a founder-member and third president of the Society, unveiled oak panels bearing the names of the former presidents, many of whom were actually present. It was unfortunate that Sir Oliver Lodge, who was president of the Society in its first two years, was unavoidably absent on this occasion. The unveiling itself, in accordance with the principles of the Society, was performed electrically by means of an engraved silver switch, which was afterwards formally presented to Dr. Forster Morley. Mr. C. F. Goodeve, this year's president, who was in the chair, then introduced the other speakers, among whom were the Provost, who accepted the panels on behalf of the College, and Prof. A. W. Porter and Prof. M. W. Travers, who made a few interesting remarks about the earlier presidents. The secretary, Mr. R. H. Leach, thanked the many friends of the Society for their assistance, financial and otherwise.

Preservation of Cliff Scenery

IN a paper to Section E (Geography) of the British Association at Norwich on September 5, Dr. Vaughan Cornish directed attention to the menace afforded by private enclosure to the best of the cliff scenery of England and Wales. Of the 1,800 miles of coast line, about five hundred are cliff land, of which more than three hundred miles are in Devon, Somerset and Cornwall. For the most part, the cliff edge is still accessible to the pedestrian, but too often the landward side has been enclosed and thus the full enjoyment of the view is impaired. Dr. Cornish calculates that 40,000 houses would line the whole of the five hundred miles, and believes that with the present rate and spread of building it will not be many years before much of the cliffs will be enclosed. He advocates the public acquisition under the Town and Country Planning Act, supplemented if possible by other funds, of a strip of land 110 yards wide along all the cliffs. This would amount in all to 20,000 acres and the purchase figure would be approximately £2,000,000. Thus, for a relatively small cost the finest scenic treasures of the country would be preserved.

Fossil Human Occipital Bone from Thames Gravels

DURING the recent meeting of the British Association at Norwich, Mr. Alvan T. Marston exhibited to Section H (Anthropology) a complete human

occipital bone which he had found in the middle gravels of the 100-ft. terrace of the Thames at Swanscombe, Kent. The bone was associated with Acheulean flint implements, and is mineralised in the same way as the bones of the Pleistocene mammals occurring with it. The fossil was submitted to the Geological Survey, and Mr. Henry Dewey confirmed the determination of its geological age. Mr. Marston now writes that he has made an endocranial cast of the specimen and has consulted Sir Grafton Elliot-Smith, who expresses the opinion that "the exceptional size and form of the visual territories upon the two hemispheres of the endocranial cast, even if they suggest left-handedness, are definitely Simian and point to a much more primitive stage than *Eoanthropus*". The bone differs considerably from the occipital of *Eoanthropus*, and further discoveries to reveal the characters of the skull to which it belongs will be eagerly awaited.

Ancient Ruins in East Africa

AN archæological reconnaissance with the view of further investigation has been made recently by Dr. L. S. B. Leakey on two sites in East Africa. Of these, one, the ruins of Gedi, an ancient city of considerable extent, sixty-five miles north of Mombasa, is already scheduled under the Ancient Monuments Preservation Ordinance; the other is the large assemblage of stone-built dwelling-places and tombs at Engaruka in the Great Rift Valley in Tanganyika, to which attention was directed as a new discovery in June last of Mr. T. E. Wetherell. The ruins at Gedi, though situated at no more than fifty yards from the Mombasa-Malindi road at their nearest point, are so obscured by a tangle of tropical vegetation as almost to escape notice. Trees of considerable size growing on or in the ruined structures afford some gauge of the antiquity of the ruins. According to Dr. Leakey's report (*The Times*, October 11) future investigation will reap a rich harvest. Town walls, buildings and tombs alike afford evidence of at least two, and possibly three, distinct periods of construction. The materials used consist of dressed blocks of coral, built up with a hard mortar and plastered to a smooth surface. In places, where the dressing is unplastered, as on the arches over doors and windows, it is extremely fine. It is Dr. Leakey's opinion that the ruins may be those of an Arab or Persian settlement of considerable antiquity, the first settlement possibly dating so far back as the beginning of the Christian era.

DR. LEAKEY'S investigations at Engaruka confirm previous reports of the extent of the site, though the limits at present are unknown. He estimates that the buildings in the North and South Ruins on the slope number five to seven thousand; and there are further structures in addition to the tomb mounds below in what he terms the Valley Ruins. The ruins are not entirely a new discovery, as recently reported. They had been visited by Dr. Hans Reck on his way to Oldoway in 1913, when he excavated one or two mounds; and more recently a little digging has been done by British administrative officials. Dr. Leakey carried out one or two exploratory excavations of mounds and buildings, but failed to obtain any material, either skeletal or cultural, which throws light on the dating of the site. It is evidently not of high antiquity. The buildings are entirely of dry stone-walling, without mortar, and show no real skill in stone building. Inquiry among the Masai elicited the tradition that the ruins had been abandoned about one hundred years ago when the Masai drove out the ancestors of the present-day Wambulu. A further tradition of a Portuguese leader or king at Engaruka may, it is thought, afford an explanation of how a people who do not now build in stone, nor live in towns or even villages, came to erect these stone structures in such numbers.

Linguistic Research in Kashmir

IT is reported that Colonel D. L. R. Lorimer, whose studies in Indo-Iranian linguistics are well known, accompanied by Mrs. Lorimer, has recently returned to Srinagar from an expedition of linguistic research among the mountain tribes of Hunza and the area to the north, upon which he has been engaged during the last fifteen months. The chief object of the expedition was to extend and complete Colonel Lorimer's studies of Burushaski, the language of the Burusho of Hunza; but he has also devoted attention to Wakki, a language of the Iranian group spoken in Wakkan and also by Wakkan settlers in northern Hunza. Colonel Lorimer, it is stated in a dispatch from Srinagar in *The Times* of October 9, has succeeded in obtaining a record of a language, Boma, hitherto unknown, spoken by a tribe of musicians and metal workers who have been settled in Hunza for many generations. According to their own tradition, they are a people of Badakhshari origin, who at some period were transferred to the rule of the Mir of Hunza for services he had rendered the ruler of Badakhshan. They have remained an exclusive group and still do not intermarry with the Burusho, although they, like the other peoples of Hunza, are Moslems. Hence while they speak Burushaski fluently, they have retained their cultural and linguistic individuality intact. Their language, which is said not to resemble the Badakhshani of their traditional place of origin, appears to be more closely related to the Sanskritic than to the Iranian members of the Indo-Iranian linguistic group. If this be confirmed by further study, it would agree with the character of other languages of the so-called Dards of Hunza. Colonel Lorimer is now about to return to England for the purpose of studying the large amount of ethnographical and linguistic material he has collected among the less well-known mountain peoples of the area.

Marine Research at Millport

THE report for 1933–34 of the Scottish Marine Biological Association, Millport, shows that much work has been done during the year. The director, Mr. R. Elmhirst, has studied specially the conditions under which shore algæ live, and subdivides the

littoral area into three natural algal belts correlated with the run of the tide. This tidal flow theory also fits closely to the observed distribution of various animal species inhabiting the sandy and muddy areas of the tidal zone. Mr. A. C. Stephen, following up his previous reports on molluscan ecology, has found that in 1933 the density of population of *Tellina tenuis* was far in excess of any previously met with, on an average 8214 per square metre. This was largely composed of a very abundant spat. The closely related *T. fabula* was also very successful in its spatting, but the conditions were evidently not so favourable for the common cockle, *Cardium edule*, very little spat of this species occurring. Dr. Orr, Dr. Marshall and Dr. Nicholls, in continuing their co-operative work on the plankton with special reference to *Calanus*, have shown that the success or failure of a brood depends on the presence or absence of diatoms during the early stages of development. A study of the chemical composition of *Calanus* showed that the fat content followed the changes in weight, and that the protein content also followed in general the changes in weight. Spent females were rarely found, which indicates that they die soon after spawning. An unusual occurrence was noted in the behaviour of Stage V *Calanus* on one occasion, when they swarmed actually on the surface of the water for two or three days, remaining in the upper few metres nearly all the time and only showing a tendency to seek deeper water during the darkest part of the night, which is a complete reversal of the normal migration. This subject is undergoing further investigation.

Public Health in England and Wales, 1934–35

THE sixteenth annual report of the Ministry of Health, 1934–35, has recently been issued, and deals under six sections with the whole subject of the public health and its administration in England and Wales (Cmd. 4978. H.M. Stationery Office, 1935. 5*s*. 6*d*. net.). Sir Kingsley Wood, the Minister of Health, in his introduction, contrasts mortality rates for the years 1910 and 1933. Thus, the death rates per 1,000 living for these two years were, respectively, 13·2 and 9·3; the infant mortality rates were 105 and 64, the death rates per million from pulmonary tuberculosis were 988 and 639, and for typhoid fever, 53 and 5. Maternal mortality, however, in spite of the development of maternity services in recent years, has not yet begun to fall. Statistics of vaccination show a slight but steady decline, from 42·6 per cent of total births in 1928 to 37·0 in 1933. Samples of food and drugs analysed during 1934 numbered 140,583, a small increase over the previous year, of which 7,451 or 5·3 per cent were reported against. It is mentioned that in some districts there are signs of revival and expansion of canal traffic, and there is evidence that motor traction of canal boats is continuing to develop, for many motor-propelled boats are on order, such boats being notable for improvements in design as regards ventilation and sanitation compared with the old type of boat.

Destructive Earthquakes in 1935

IN a recent number of the *Matériaux pour l'Étude des Calamités* (No. 35, 82–86; 1935), M. Charles Bois continues his record of destructive earthquakes. During the first six months of this year, there were 16 such earthquakes, four of them resulting in considerable loss of life, namely, the Persian earthquake of April 11 (480 deaths), the Formosa earthquake of April 20 (3,065), the Caucasian earthquake of May 1 (600) and the Quetta earthquake of May 30 (40,000). The latter number is probably too high, the latest estimate being about 30,000. On the other hand, the number of deaths (2,000) given by M. Bois for the Bihar earthquake of January 15, 1934 (NATURE, **136**, 472, September 21, 1935), is too low, the number given in the official report on the earthquake being more than 10,000.

Third World Power Conference

THE third World Power Conference will be held in Washington, U.S.A. on September 7–12, 1936. This will be the third plenary meeting of the World Power Conference, the first plenary meeting having taken place at Wembley in 1924, and the second at Berlin in 1930. There have, in addition, been a number of sectional meetings. The Chemical Engineering Congress of the World Power Conference, to be held in London next June, ranks as one of these series of sectional meetings. The general subject to be discussed at the Third World Power Conference is "National Power Economy". Among the aspects to be treated are the following: physical and statistical bases; technical, economic and social trends; organisation of fuel industries and of gas and electric utilities; public regulations; national and regional planning; conservation of fuel and water resources; rationalisation of distribution; national power and fuel policies. The second Congress of the International Commission on Large Dams of the World Power Conference will be held in Washington at the same time. Further particulars regarding the plenary meeting of the World Power Conference and the second International Congress on Large Dams will be issued in due course. British participation will be organised by the British National Committee of the World Power Conference, 36 Kingsway, London, W.C.2.

Work of the Medical Research Council

IN a pamphlet by Miss Norah Dacre Fox, issued by the London and Provincial Anti-Vivisection Society, an attempt is made to criticise the work carried out under the Medical Research Council. Reference is made to the dominating influence of the late Sir Walter Fletcher, to vested interests, to a suppressed report, etc. It is stated: "The public is the Master, the Medical Research Council its servant. Is it not entitled to assert itself and to require from those it remunerates so lavishly, an account of this stewardship?" Needless to say, an account of this stewardship is available to all who desire it in the annual report and in the numerous research reports issued by the Council.

Announcements

PROF. JOHN A. RYLE, regius professor of physic in the University of Cambridge, and Prof. Matthew J. Stewart, professor of pathology in the University of Leeds, have been appointed members of the Medical Research Council in succession to the Right Hon. Lord Dawson of Penn, and Prof. A. E. Boycott.

AT the annual dinner of the Institute of Fuel, held on October 9, the Melchett Medal was presented to Mr. Harry R. Ricardo for his work on internal combustion engine operation and its relation to fuel.

AT the annual general meeting of the Association of British Chemical Manufacturers, Dr. E. F. Armstrong was elected president in succession to Sir Christopher Clayton.

THE new auxiliary laboratory of the British Electrical and Allied Industries Research Association will be opened by H.R.H. The Duke of Kent at Perivale, Middlesex, on October 22, at 3 p.m.

The eleventh annual Norman Lockyer Lecture of the British Science Guild will be given by Sir Josiah Stamp, who has chosen as his subject "The Calculus of Plenty". The lecture is to be delivered in the Goldsmiths' Hall (by permission of the Goldsmiths' Company) on Wednesday, November 13, at 4.30 p.m.

DR. E. L. HIRST will deliver a lecture on "The Chemical Nature of Vitamins" before the University of Durham Philosophical Society on November 1 at 6.30. The meeting will be open to the public.

SIR WALTER LANGDON-BROWN will deliver the fifth Victor Horsley Memorial Lecture in University College Hospital Medical School, Gower Street, W.C.1, on November 19 at 5 p.m. The subject of the lecture will be "The Integration of the Endocrine System". Admission to the lecture will be free.

IT has been decided to hold the Huxley Lecture at the Imperial College of Science and Technology in alternate years only, and in the other years to hold lectures commemorating other distinguished men who have served on the staff of the College. The first of the new series of lectures will be held on May 4, 1936, at 5.30 p.m., and will be given by Prof. G. T. Morgan. The lecture will be called "The Hofmann Memorial Lecture".

THE second Hinchley Memorial Lecture of the Institution of Chemical Engineers will be delivered by Sir Harold Hartley on October 25, at 6.30, in the Lecture Theatre of the Institution of Civil Engineers, Great George Street, S.W.1. The subject of the lecture will be "Our National Coal Resources". The lecture is open to non-members, for whom tickets can be obtained from the Assistant Secretary, Abbey House, Westminster, S.W.1.

THE first Italian congress on alimentation, organised by the National Medical Syndicate, the committee for the study of the problems of alimentation and the National Research Council, will be held in Rome on October 23–26. At the inaugural meeting, Prof. Filippo Bottazzi will speak on the organisation of scientific research in the service of the national food supply, and Prof. Eugenio Morelli will discuss the work of the doctor in alimentary propaganda.

PROF. BERNARDO A. HOUSSAY, of the Institute of Physiology, Buenos Aires, has been appointed a member of the Permanent International Committee of the Physiological Congresses. The names of the other members of the Committee were given in NATURE of October 12 in the article on the recent Congress held in the U.S.S.R. (see p. 573). Prof. Houssay's election is a welcome acknowledgment of the value of the work of the growing schools of physiology in South America.

MESSRS. ALLEN AND UNWIN, LTD., announce the early publication of "Coral Gardens and Their Magic" by Prof. Bronislaw Malinowski; also "How Animals Develop" by C. H. Waddington, which affords a short account of the science of embryology.

MESSRS. W. Watson and Sons, Ltd., 313 High Holborn, W.C.1, have recently circulated a new issue of part 6 of their microscope catalogue, dealing with microscopes and accessories for polarising purposes, which will be sent gratis to those interested. Two new models have been introduced, the 'Service', 'School of Mines', and 'Advanced' petrological models have been re-designed, and the last two can now be supplied with horse-shoe, instead of tripod, foot if preferred. A demonstration set has also been designed for school purposes in order to demonstrate the phenomena of polarised light, and other new patterns of apparatus are figured and described.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in mining in the University of Leeds—The Registrar (Oct. 22).

An examiner in the Aeronautical Inspection Directorate—The Secretary (S.2.d.), Air Ministry, Kingsway, W.C.2 (Oct. 26).

An assistant engineer in the Chief Engineer's Department of the London County Council—The Clerk to the Council, County Hall, S.E.1 (Oct. 28).

A lecturer in electrical engineering and a lecturer in mathematics and electrical engineering in the South-East London Technical Institute—The Education Officer, County Hall, S.E.1 (Oct. 28).

A junior scientific officer and an assistant (III) at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Oct. 30).

A lecturer in mathematics in the Edinburgh Training Centre—Prof. Godfrey H. Thomson, Director of Studies, Moray House, Edinburgh, 8 (Oct. 30).

A lecturer in mathematics in the Saltley Church of England Training College for Schoolmasters, Birmingham—The Principal (Nov. 1).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 647.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

'Autogenous' Strains of '*Culex pipiens*' (Diptera, Culicidæ)

IN a letter published in NATURE of January 5, 1935 (135, 34), we directed attention to the discovery, at Hayling Island (Hampshire), of a 'strain' of the mosquito *Culex pipiens* exhibiting certain abnormal characteristics (notably the ability of the females to lay fertile eggs upon a blood-free diet) which Roubaud has designated by the adjective 'autogenous'. Such autogenous strains of *C. pipiens* had previously been recorded only from France[1], Germany[2], Greece[3], Hungary[3] and Malta[3]. Roubaud, who considered his autogenous strain and the ordinary ('anautogenous') strain to be morphologically identical[4], indicated their biological differences by naming them respectively *Culex pipiens autogenicus* and *Culex pipiens pipiens*[5].

We find that, in three different stages of development, the Hayling autogenous strain of *C. pipiens* can be morphologically distinguished from the anautogenous strain. The adults are recognisable by the lighter colour of the thorax, by the greater average number of hairs on the lobes of the 9th tergite, and by the shortness of the male palps; the larvæ, by their much lower siphonal index and by the greater average number of branches in the siphonal tufts; and the eggs, by their greater width relatively to their length. The female adults (as already noted in the case of other autogenous strains) also differ from the anautogenous ones by reason of the fierceness with which they attack human beings.

Our investigations prior to March 8 last are fully described in an article about to appear in *Parasitology* (27, No. 4), the editor of which journal, Prof. D. Keilin, has very kindly given us permission to refer in this letter to the two subsequent developments summarised below.

(1) In our *Parasitology* article we allude to the (hitherto unexplained) fact that females of *C. pipiens*, although regarded in England as being chiefly 'bird-biters', occasionally exhibit 'man-biting' proclivities in residential districts. We have made the suggestion (supported by evidence provided by the examination of man-biting adults captured in a London hotel in the year 1930) that, in all such cases, an autogenous strain of *C. pipiens* has been concerned. Opportunities of confirming the validity of this assumption have recently been furnished by infestations of man-biting *C. pipiens* in (*a*) a block of flats in Westminster and (*b*) a row of cottages in Hull. Both from a blood-filled female (caught in a bedroom) in the first case, and from larvæ collected near the infested buildings (by kindness of the Medical Officer of Health for Hull, Dr. Gebbie) in the second case, we have established, and are maintaining, an autogenous strain.

(2) We are now rearing autogenous strains derived from Hayling, London, Hull, France and Greece—the last two by kindness of Prof. Roubaud and Dr. P. Tate respectively. We are indebted to Dr. Tate also for larval and adult specimens of the Hungarian and Maltese strains. We find that all these strains resemble one another, but differ from the anautogenous *C. pipiens* in the following respects. In the larvæ, the siphonal index lies between 3·8 and 4·3; in adults of both sexes, the thorax is light-coloured; in male adults, the first division of the mesosome is unusually broad and the combined length of the first four segments of the palp does not exceed the overall length of the proboscis; in female adults, the venter is, both medianly and laterally, devoid of dark scales.

In regard, however, to the chætotaxy of the larval siphon and of the 9th tergites, the seven strains differ noticeably from one another. In the Hungarian strain, for example, the 'tuft-branch' count is low and the 'tergite-hairs' count high; in the Hayling strain, both counts are high; and in the London strain, they are both low. A remarkable characteristic of the Greek strain is the large proportion of larvæ (about 40 per cent) which have three siphonal tufts instead of four.

It appears, therefore, that Roubaud's original (French) *C. pipiens autogenicus* is but one of a number of autogenous strains, all of which differ very markedly from the anautogenous *C. pipiens*, and also—to a lesser but quite obvious extent—from one another. In view of this fact we submit the suggestion that some specific name other than *pipiens* should be adopted to designate both the present and later-discovered members of this autogenous, short-siphoned, short-palped group: varietal names (preferably of geographic import) being appended whenever the recognition of definite morphological or biological differences renders such action desirable. In favour of reviving the specific name *domesticus*, Germar, for this purpose there is a great deal to be said.

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J. STALEY.

British Mosquito Control Institute,
Hayling Island, Hants.
Oct. 8.

[1] Roubaud, E., *C.R. Acad. Sci.*, 188, 735; 1929.
[2] MacGregor, M. E., *Trans. Roy. Soc. Trop. Med. and Hyg.*, 26, 307; 1932.
[3] Tate, P., and Vincent, M., *Parasitology*, 28, 512; 1934.
[4] Roubaud, E., and Toumanoff, C., *Bull. Soc. Path. exot.*, 23, 196; 1930.
[5] Roubaud, E., *Ann. Sci. nat.* (10), 16, 5; 1933.

Gorilla Skulls in the Bristol Museum

In the course of rearrangement of the study collections in the Department of Zoology, it has recently been discovered that the Bristol Museum and Art Gallery possesses the three gorilla skulls (Reg. Nos. Ab 1993, 1994, 1995) from which Prof. (afterwards Sir Richard) Owen first described this animal to the Zoological Society of London in a paper read on February 22, 1848. This was published in *Trans. Zool. Soc.*, 3, pp. 381–422 (1849) and Plates LVIII–LXIII as "Osteological Contributions to the Natural History of the Chimpanzees (Troglodytes, Geoffroy) including the description of the skull of a large species (Troglodytes Gorilla, Savage) discovered by Thomas S. Savage M.D. in the Gaboon Country, West Africa". One of the skulls (Ab 1993) is figured in Plates LXI–LXIII and, as related on p. 391, they were procured in December 1847.

In a later paper by the same author in *Trans. Zool. Soc.*, 4, pp. 75–77 (1862), a detailed description is given of another skull (Ab 1996), and it is figured in Plates XXVI–XXVIII. The bisection of the skull was carried out under Prof. Owen's direction as mentioned on p. 77.

Casts of these four skulls were presented to the Museum of the Royal College of Surgeons in 1848, and appear as Nos. 5180–5183 in "Descriptive Catalogue of the Osteological Series. Vol. II. Mammalia Placentalia" (1853) where, on pp. 803–805, there are descriptions, including a further detailed one of Ab 1996.

Some more notes are given on p. 9 of a later "Catalogue of Specimens illustrating Osteology and Dentition of Vertebrated Animals, Part II. Mammalia other than Man" (1884) by W. H. Flower and J. G. Garson.

In addition to the above, there are in the collections another skull of a male presented at the same time (1848) as Ab 1996, and a mounted adult male and its skeleton received in 1865.

Details of these specimens are as follows:

(1) Skull of adult male, without mandible, procured by Capt. George Wagstaffe at the Gaboon River, West Africa, in December 1847. Brought to England by Capt. Wagstaffe, ship *Jno. Cabot*. Donor: Mr. S. Stutchbury, August 3, 1848. Reg. No.: Ab 1993.

(2) Skull of mature male, without mandible, same history and donor as No. 1. Reg. No.: Ab 1994.

(3) Skull of adult female, without mandible, same history and donor as Nos. 1 and 2. The top of the cranium has been divided from the rest of the skull. Reg. No.: Ab 1995.

(4) Skull of adult male without mandible, from River Danger (=Muni River), West Africa. Donor: Capt. Harris, ship *Englishman*, August 3, 1848. (This skull was bisected vertically and longitudinally later.) Reg. No.: Ab 1996.

(5) Skull of male, without mandible, from River Danger, West Africa. Donor: Mr. Townsend, ship *Englishman*, August 3, 1848. Reg. No.: Ab 1997.

(6) Mounted specimen of adult male from Gaboon River, West Africa. Donor: Mr. A. Gordon, of Gaboon, December 30, 1865. Reg. No.: A 4890.

(7) Complete skeleton of No. 6. The height of the animal was 5 ft. 5 in. Reg. No.: A 4837.

H. Tetley.

Bristol Museum and
Art Gallery.
Oct. 3.

Ring Deposits on Glass by Positive Ray Bombardment

Positive rays of hydrogen were passed through a hole of 2 mm. diameter and 6 mm. long in the centre of a cathode of brass faced with an aluminium plate. A glass window kept perpendicular to the beam, eleven centimetres behind the front face of the cathode, showed formations of deposits with well-defined rings after the tube was worked at different cathode falls corresponding to a maximum of 25,000 volts D.C., current 1·7 m. amp. The total time of exposure was about twenty-five hours. On examination by transmitted light of the place where the rays fell directly, it was found to be transparent. The rings were brown. The first ring is sharp and circular, with a thickness of 0·5 mm. and a diameter of 8 mm. The second ring is also quite circular, of the same thickness as the first, but not quite concentric with it. The diameter of this ring is about 16 mm. only; two-fifths of the third ring is visible, the diameter is 24–30 mm., but it is nearly concentric with the second ring.

The deposits have been observed by previous workers, but not the rings. Von H. Raether[1] examined similar deposits by electron diffraction, and concluded that they must be due to carbon formed from the decomposition of the hydrocarbons present in the discharge tube and produced from grease or at wax joints. The rings cannot be due to interference. The phenomenon presents many interesting features as a closer extended study with excellent photographic results has revealed, and will be reported in detail elsewhere.

B. Dasannacharya.
V. T. Chiplonkar.
L. G. Sapre.

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Hindu University,
Benares.
Aug. 25.

[1] *Phys. Z.*, 34, 492; 1933.

Spectra of SeO and SeO_2

In continuation of earlier work[1] on SO_2, the emission bands of SeO and the absorption bands of SeO_2 have been analysed. The former consist of a long $v'=0$ progression and a short $v'=1$ progression. The origin of the system cannot be definitely located but the $v'=0$ progression can be expressed by the following formula

$$\nu = 30433 - (882\, v'' - 6\, v''^2).$$

Considerations of intensity distribution lead us to 33167 cm.$^{-1}$ as ν_0 and $\omega''=910$ cm.$^{-1}$, and the energy of dissociation of unexcited SeO will therefore be 4·17 volts. The vibrational frequency of the excited state ω' is 513 cm.$^{-1}$

The analysis of the spectrum of SeO_2 indicates two modes of vibration ω_2 and ω_3 both in the ground and in the excited state, the deforming vibration ω_1 being absent. The frequencies of the symmetric valence vibration are $\omega_2''=901$ and $\omega_2'=663$ cm.$^{-1}$; those of the antisymmetric valence vibration are $\omega_3''=1189$ and $\omega_3'=790$ cm.$^{-1}$. The origin of the system lies at 32560 cm.$^{-1}$.

The theoretical selection rule for $\Delta v_{\text{antisym.}}$ of Herzberg and Teller[2] is found to be completely valid.

The close correspondence of the two energies of excitation, ω'' and ω'', ω' and ω_2'' of SeO and SeO_2 respectively, indicate strong localisation of the bonds.

This is corroborated by the atomic heat of formation of selenium dioxide, which has been calculated as $Se+O+O=SO_2+8\cdot9$ volts, which is almost double the energy of dissociation of SeO.

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Dept. of Physics,
Muslim University,
Aligarh.
Sept. 1.

[1] R. K. Asundi and R. Samuel, *Proc. Ind. Ac. Soc* (Bangalore), 2, 30; 1935.
[2] G. Herzberg and E. Teller, *Z. Phys. Chem*, B, 21, 410; 1933.

The *L*-Emission Spectrum of Argon

OF the X-spectra of rare gases, the *K*-series of xenon and that of krypton have been measured[1], and from their absorption spectra the *K*-edge of argon[2], krypton[3] and the *L*-edge of xenon[3] are known. For the *L*-absorption edge of Xe, as well as for the *K*-edge of argon[4], a fine structure also has been found.

In the region of the long wave-lengths, no results obtained by direct measurements have been obtained hitherto. The values for absorption edges have been obtained by the method of magnetic spectra.

By studying with our ionic tube the reversed absorption edges of silver, bromine and potassium in the region of long wave-lengths[5] (which we will publish later on), we have found that if either N_2 or air has been let into the tube, the *K*-series of N_2 has occurred. Sometimes, there also appeared the absorption edge of nitrogen[6]. The absorption edge of N_2 appeared especially when the same pressure had been maintained in the spectrograph as in the ionic tube. Such a regulation and maintenance of the pressure in the spectrograph—which is possible by the application of the ionic tube—is important in the region of the long wave-lengths, where it is impossible to cover the slit. (The gas, which is let into the tube by means of a fine regulating glass valve[7], streams through the slit into the spectrograph, from which it is exhausted.) We have tried to obtain spectra of the rare gases mentioned with the arrangement described above, where the said ionic tube offers a very efficient source of the long X-rays[8]. It is now possible to operate with this tube with a tension of only 600 v. at 250–300 ma. The pressure in the tube under the given conditions is about 0·1 mm. Hg.

When argon is let in the above-mentioned way into the tube, the *L*-series of argon is obtained. As electrodes we have used aluminium with the deposit of lithium borate on the anticathode. For control, if H_2 has been let in instead of argon, only *K*-lines of boron (in 8 orders), *K*-lines of lithium and the *K*-absorption edge of carbon in the first and the second orders have been obtained. But when argon is let in, besides the expected argon lines, we have obtained also new lines, which are observed when H_2 has been the discharge gas. These new lines have been found to belong simply to the elements calcium, sodium and silicon, which elements have been sputtered on the anticathode from some parts of the tube by the presence of argon. The *L*-series of argon have been measured with reference to the lines of boron[9], and the following values have been obtained

	λ	ν/R	ν/R cal.
L_β	56·1	16·2	16·29
$L\eta$	56·7	16·1	16·13

The observed values (measured in the second order) agree well with those calculated by interpolation of the data from Siegbahn and Magnusson[10]. We have not succeeded hitherto in obtaining a distinct character of the absorption edge of argon. The short wave limit of these lines is 54·0 A., which differs from the value given by Holweck (50·1 A.) and by Turner (50·7 A.) by about 3 A. Our results show that, with certain modifications of our arrangement, such a pressure is obtainable that we can expect the above mentioned absorption edges of argon, as well as of other gases, in the region of long wave-lengths.

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Spectroscopical Institute
of the Charles University,
Prague.
Sept. 16.

[1] A. Dauvillier, *C.R.*, Paris, 191, 937; 1930.
[2] H. Fricke, *Phys Rev.*, 15, 202; 1920.
[3] Y. D. Hanawalt, *Phys. Rev.*, 37, 715, 1931.
[4] D. Coster and Van der Tuuk, *Z. Phys.*, 37, 367; 1926 NATURE, 117, 586; 1926.
[5] V. Dolejšek and V. Kunzl, *C. Y. M. Fys.*, 61, 242; 1932. *Z. Phys*, 74, 565; 1932.
[6] J Thibaud, *J. Phys et Rad*, 8, 447; 1927.
[7] V. Kunzl and J. Slavík, *Z. Techn. Phys*, August, 1935.
[8] V. Kunzl, NATURE, 136, 437; 1935.
[9] M. Siegbahn and T. Magnusson, II, *Z Phys*, 87, 305; 1935.
[10] M Siegbahn and T Magnusson, IV, *Z Phys*, 95, 149; 1935.

Dipole Moments of Ethyl and *Iso*-amyl Borates and Triphenyl Phosphate

SOME months ago we commenced an examination of the dipole moments of esters of inorganic acids.

Otto[1] has now published the dipole moments of *n*-butyl borate and *n*-amyl borate as 0·77 D and 0·79 D, respectively, at 25°, in benzene. We have found that ethyl and *iso*-amyl borates have moments of 0·75 D and 0·81 D, respectively, at 20°. The values for *n*- and *iso*-amyl borates are, therefore, in good agreement, and there seems to be a slight increase in the moment in ascending the series of alkyl groups. Triphenyl phosphate has, we find, a moment of 2·79 D.

The borates were fractionated several times, and the triphenyl phosphate recrystallised twice from petrol ether. As the borates are extremely easily hydrolysed, great care was necessary to avoid exposure to air. The dielectric constants were measured by the apparatus previously used[2], except that a glass dielectric cell containing platinum plates, the inlet and outlet tubes of the cell being fitted with ground glass caps, was employed. Benzene was the solvent and all the measurements were at 20° C.

The results were:

Compound	B. Pt.	d_4^{20}	n_D^{20}	P_∞	P_E	μ
Ethyl Borate	119·2°/756 mm.	0·8635	1·3741	50·5 c c.	38 63 c.c.	0·75 D
Iso-amyl Borate	256 1°/761 mm.	0 8514	1·4156	94·3	80 20	0 81 D
Triphenyl phosphate	49·8° (M.Pt)			252·5	87 41[3]	2·79 D

Work is in progress on other esters, and the results will be discussed when the measurements have been completed.

E. G. COWLEY.
J. R. PARTINGTON.

Queen Mary College,
University of London.
Sept. 13.

[1] Otto, *J. Amer. Chem. Soc*, 57, 1477; 1935.
[2] Cowley and Partington, *J. Chem. Soc.*, 604; 1935.
[3] Value calculated from sum of atomic refractions for D line

Structure and Oxidation of Nitrogenous Substances

It has been reported elsewhere[1] that organic nitrogen in plant materials, soil organic matter and extracted proteins undergoes partial oxidation to nitrate on treatment with a mixture of sulphuric and chromic acids. It has since been found that the proportion of total nitrogen recovered as ammonia is constant for each substance, provided the oxidation is completed under conditions of reduced pressure and moderate temperature[1], and sufficient of the substance be taken to contain more than 20 mgm. of nitrogen. Of the fraction not recovered as ammonia, a portion is oxidised to nitrate and the rest is lost in gaseous form, probably as nitrogen or nitrous oxide. The 'oxidation constants' bear definite relationship to the structure of the compound.

While, in the case of compounds having nitrogen atoms attached to different carbon atoms, full recovery of nitrogen is obtained in the form of ammonia and nitrate, a definite portion is lost in gaseous form with compounds having two or more nitrogen atoms linked to the same carbon atom. The proportion of ammonia recovered from some typical groupings are as follows: –NH–CO–NH– group, 2/3 of total nitrogen; $CH\leqslant^{N<}_{N-}$ group, 4/5; guanidine group, 4/11; creatine group, 2/3. The hydroxylamine derivatives are almost quantitatively oxidised to nitrate, while the nitrogen in hydrazine derivatives is almost completely lost in gaseous form.

Chlorides present as impurity in commercial samples and as hydrochlorides of bases tend to increase the proportion of nitrate formed at the cost of ammonia, and should be removed by precipitation with Ag_2SO_4. The possible significance of these 'oxidation' constants in relation to the structure of complex substances, for example, proteins, is under examination.

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Sept. 18.

[1] *Proc Biochem Soc., J. Soc. Chem. Ind.*, 54, 596, 1935.

Phonemes

The terminological confusion which has long plagued linguistic study has latterly been particularly acute in the matter of the phoneme. The recent communication[1] of Prof. E. W. Scripture does not appear likely to improve the situation.

Prof. Scripture proposes to apply the term 'phoneme' to "one of a group of similar sounds". Hitherto, the term has been used as referring to the group itself, as including the various similar (that is, only slightly different) sounds which were regarded then as 'members of a phoneme'. Prof. Scripture's proposal leaves unspecified the group itself; and it is precisely the inclusive, aggregational property which is most important. Prof Scripture would call the *t* of *tip* a phoneme, and the *t* of *pit* another phoneme; but he has no name to apply to the group which includes these and all other *t*'s.

This departure from the small measure of agreement which has been reached on the phoneme might be justified, of course, if Prof Scripture could adduce valid evidence of the usefulness of this innovation. But there is patently no advantage in shifting the application of a term from a group to an individual member of the group. The essential problem is the determination of the group[2]. Only if Prof. Scripture has some new and more successful procedure for sorting all the sounds of a language into definite and mutually exclusive categories can his proposal be considered seriously.

Prof. Scripture believes "that phonemes do exist", and thus takes his stand with those who hold that a phoneme is (or corresponds to) an observable physical reality of some order. This reality Prof. Scripture finds in sound-track recordings. His position thus corresponds in certain essential respects to that which Bloomfield developed more fully in his "Language". But Prof. Scripture does not indicate how the "group of sounds" are to be determined, aside from a casual assurance that "On comparing the records we find that groups of similar speech sounds can be formed". Thus far, I know of no evidence from the laboratory that records of *tip* and *pit* will show physical peculiarities to justify grouping together the *ts* or the *ps* on the basis of positive similarity. For to group together the *ts* on this basis presupposes not only the discovery of positive similarities as among various kinds of *ts* but also the determination of some physical peculiarities associated only with *ts*. The group can be established on a laboratory basis only by the discovery of characteristics which are constantly present for this group, and never present for any other group.

Prof. Scripture cannot be unaware of the objections raised to Bloomfield's essentially similar proposal, and it is impossible that his suggestion in Nature should have been made jocosely or irresponsibly. One can only conclude that he has discovered a method for the determination of positive, exclusive physical properties of the various members of a phoneme (in his terminology, the various phonemes of a group). The announcement of his discovery will be welcomed as a partial solution of this vexing phonetic-phonological problem.

Still unsolved, however, will be the problem of differing phonemic distributions of similar sounds in different languages. Recordings of an American pronouncing *battle* and an Englishman pronouncing *barrel* would show a high order of similarity in the intervocalic consonant, which belongs definitely in a *t*-group for the American and in an *r*-group for the Englishman.

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Sept. 3.

[1] Nature, 136, 261, Aug 17, 1935.
[2] Cf. *Language Monograph*, 16, 17–32.

In a collection of sound film registrations I find quite a number of regions that resemble the one reproduced in Fig. 1. Such a region consists of a series of bits of vibration with many peaks of different heights and periods of repetition and several vibratory movements of less sharp character, all of them beginning strong and fading to zero. Each bit of vibration can be characterised by its duration and by the systems of peaks and less sharp movements with their heights, periodicities and decrements. An entire region will be characterised not only by all the measurements for the individual bits but also by the numbers for their differences and order of sequence. Every region will have a more or less similar, but yet different, set of numbers for each of its characteristics.

For the group formed from the similar cases there will be for each characteristic an average value a, an average variation v and a limit of variation l. For the whole set of i characteristics there will be the averages $a_1, a_2, \ldots, a_i$, the average variations $v_1, v_2, \ldots, v_i$, and the limits of variation l_1 $l_2, \ldots, l_i$. The term 'phoneme' might be used to indicate: (1) the whole group of speech sounds with characteristics specified in this way, or (2) a speech sound defined with averages of these characteristics, or (3) a speech sound that may be any one of the group with these characteristics. The choice depends on convenience and accuracy. If we say that a person pronounced the word indicated in print by *hatch* with the phoneme æ, we do not mean that he used a whole group or an average; we can only mean that he used one of a group. If, however, we say that the speech of a person or a dialect is characterised by the use of the phoneme æ, any one of the three meanings is appropriate.

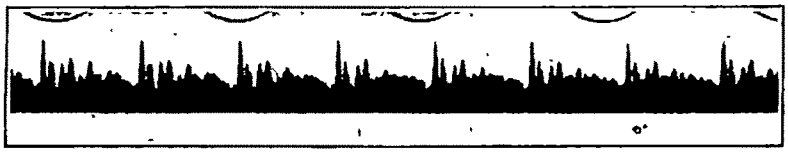

FIG. 1. A few waves of the sound track of the vowel in a film record of 'hatch'.

The essential point is that a new and successful method does exist for accurately and minutely specifying and sorting all the sounds of a language into definite and mutually exclusive categories, namely, the measurement of records of speech. This method transforms phonetics and linguistics from indefinite disciplines into exact sciences. It must be understood that science deals only with observables (Heisenberg) and that our knowledge is limited to the numbers obtained from the observables (Eddington and others). The entities that produce these numbers are not only unknowable but are also unmeasurable (Dirac). A statement that a speech sound consists of a certain set of measurement-numbers is a scientific fact that can be used. A statement that it is like the sound of *t* in *tip* conveys no definite information unless the measurement-numbers are given. If we mean anything else than these measurement-numbers we are claiming knowledge of the unknowable.

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Mechanism of Glyoxalase Activation by Glutathione

WE have investigated the specific co-glyoxalase action of glutathione, discovered by Lohmann[1]. Giršavičius and Heyfetz[2] have shown that the spontaneous combination of glutathione and methyl glyoxal in aqueous solution leads to a state of equilibrium; formation and dissociation of the compound proceed, in not too acid solution, with great rapidity. The dependence of the velocity of the enzymic reaction on the initial concentrations of glutathione and methyl glyoxal (Platt and Schroeder[3]) and of their compound (unpublished work of ours) leads to the conclusion that of the three substances—free glutathione, free methyl glyoxal, and the compound—it is the latter that is the true substrate of glyoxalase action (though one of the other two may also be playing a part).

It is a striking fact that although widely differing reaction velocities are obtained when different initial concentrations of glutathione and of methyl glyoxal are used, yet *at all concentrations and velocities* the reaction proceeds linearly (zero order) until almost complete exhaustion of the methyl glyoxal. To shed some light on this fact, unusual in enzyme kinetics, we followed the changes in free sulphydryl in the course of the reaction. The lactic acid production by the enzyme was determined by gradual titration with alkali, the hydrogen ion concentration of the buffer-free solution, which contained an indicator, being kept constant. From time to time, samples were strongly acidified and rapidly titrated with iodine in presence of starch. We expected a gradual reappearance of the glutathione originally bound to methyl glyoxal. The results actually obtained are shown in Fig. 1. The greater part of the initially present free glutathione (less than half of the total; the rest is combined with methyl glyoxal) rapidly disappears after addition of the enzyme. The amount of free —SH group of the glutathione remains at a low value during most of the reaction; finally, as the reaction comes to an end and its velocity begins to fall, all the —SH, including that originally combined, rapidly reappears again. All the while the acid production proceeds at a steady rate.

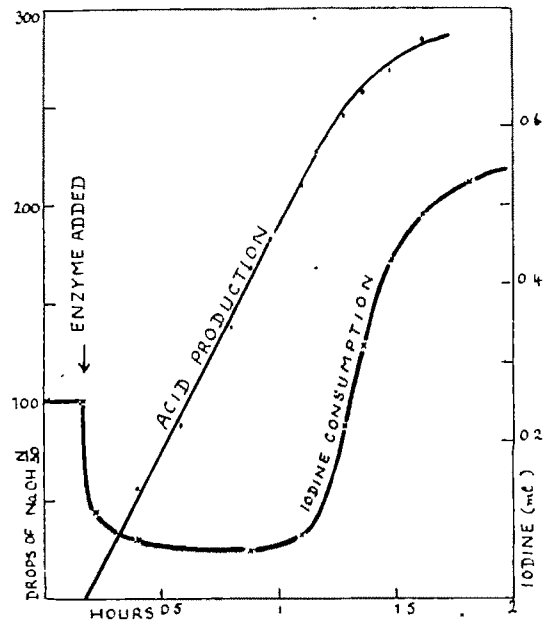

FIG. 1.

We have not yet investigated how the glutathione is 'hidden' during the reaction. A more complete combination with methyl glyoxal under the action of the enzyme (less than 0·5 mgm. of a purified preparation in 1 mol.) would appear to be ruled out by the chemical equilibrium involved. A dismutative reaction, with intermediate formation of other substances than lactic acid, is contradicted by the observation of Ariyama and Kobayashi[4] that lactic acid production is equal to loss of methyl glyoxal throughout the reaction.

Whatever the actual chemical reactions involved, it can be stated in general terms that the glutathione first combines by means of its —SH group with the substrate, methyl glyoxal, and then, as the enzyme-catalysed reaction develops, enters into some further transformations, again involving its —SH group. This observation seems of interest for the role of sulphydryl compounds in biochemical catalysis generally.

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Moscow.

[1] *Biochem. Z.*, **254**, 332, 1932.
[2] *Biochem. Z.*, **276**, 190; 1935
[3] *J. biol. Chem*, **104**, 281; 1934.
[4] *J. Biochem.* (Tokyo), **16**, 317; 1932.

Blood Group Inheritance

WE agree with Prof. Haldane's view[1] that the existence of a fourth allelomorph underlying the inheritance of blood groups (equivalent to the theory proposed by us[2]) cannot be regarded as proved until tested in some such way as he suggests. The published statistics of many investigators, collected by Lattes[3], do not give sufficient information about individual families for the points raised by Prof. Haldane to be dealt with immediately.

Of the alternative theories suggested, mutation is discounted for the reason Prof. Haldane surmised: it would need to occur about ten times as frequently in $AB \times O$ matings as in the other cases where anomalous offspring have been recorded. The hypothesis of trisomy is unsatisfactory in that while it explains the occurrence of AB offspring from $AB \times O$ matings, it fails to account for the O offspring, which according to Lattes[4], Furuhata[5] and Bauer[6] are not less frequent. (Each type comprises about 5 per cent of the total progeny.)

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I. M. H. ETHERINGTON.
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Oct. 2.

[1] NATURE, **136**, 432, Sept. 14, 1935.
[2] NATURE, **136**, 297, Aug. 24, 1935.
[3] Lattes, "Individuality of the Blood" (Oxford University Press, 1932).
[4] ibid., p. 149.
[5] Furuhata, *Japan Medical World*, **7**, No. 7; 1927.
[6] Bauer, *Klin. Wochenschr*, **7**, 1588, 1928.

Effect of Vitamin C (Ascorbic Acid) on the Growth of Plants

REFERRING to the letter from Miss Synnöve v. Hausen[1], I gladly acknowledge the priority of her paper, the existence of which was unknown to me when publishing mine on the same subject. Such coincidences are frequent in research work. More important, however, than similar questions of priority is the fact that our experiments have resulted, in a new field of research, in mutual confirmation, although worked out independently and with different methods.

There is yet another point which I wish to stress, and that is: the new proof given of the great utility of the 'correspondence' columns of NATURE in giving early news in the field of research and in bringing together research workers who would not otherwise know of each other's work. This is particularly the case with publications in languages which are read by relatively few people outside the countries in which they are used.

LÁSZLÓ HAVAS.
Rothamsted Experimental Station,
Harpenden, Herts.
Oct. 3.

[1] NATURE, **136**, 516, Sept 28, 1935.

Zinc and Plant Metabolism

RECENT investigations by Reed and Dufrénoy[1] on the condition known in *Citrus* culture as 'mottle-leaf' are of great interest to the plant physiologist apart from their practical value to the industry. Results obtained from field treatments in conjunction with microchemical examination have suggested that zinc plays an important role in controlling the oxidation-reduction equilibrium of the leaf cells. Application of zinc, either through the soil or in the form of a spray to the foliage, leads to rapid recovery from the 'mottled' condition, associated with profound cytological changes including the production of chlorophyll.

During a visit to California in the early part of this year, I was fortunate in seeing these experiments. The contrast between the yellow-leaved control trees and those that had been sprayed a few months previously with zinc sulphate solution and were now bearing dark green, healthy foliage was truly striking. There can be no question as to the efficacy of the treatment, surprising though it may be that effective amounts of zinc can be absorbed by leaves with a cuticle so thick as that of *Citrus*.

It would be regrettable if these investigations, through their publication in a periodical mainly devoted to agricultural science, should escape the attention they deserve from plant physiologists who may have no direct contacts with applied work.

W. NEILSON JONES.
Bedford College,
University of London.
Oct. 3.

[1] H. S. Reed and J. Dufrénoy, "The Effects of Zinc and Iron Salts on the Cell Structure of Mottled Orange Leaves", *Hilgardia* (Univ. of Calif., Berkeley, Calif), **9**, 113–135; 1935.

Prevention of Clogging of Strainers in Rearing Aquatic Organisms

WALTON SMITH has recently[1] described apparatus which overcomes several difficulties in rearing marine larvæ in flowing water, one special point being the waxing of the bolting silk strainers to retard clogging. I encountered the clogging in rearing *Metriocnemus longitarsus*, Goet. (Diptera, Chironomidæ) larvæ in flowing water, the overflow strainer being rapidly stopped up by the algal food and dejecta.

A 500 c.c. distilling flask was provided with a rubber bung through which passed a short 4 mm. bore glass tube as inlet, its inner end closed with a strainer, as these larvæ attempt to leave their vessel. A second piece of tube was bent to an appropriate angle and one limb cut off very short. The short limb was fixed tightly into the inner end of the delivery tube of the flask by a rubber

ring and the long limb projected into the body of the flask, but not directly below the inlet tube. Its lower end was just clear of the surface when the flask was half-filled with water and was closed by a fine strainer, thin cotton cloth being used as the larvæ nibbled bolting silk and so escaped. A rubber connexion between the inlet tube and a cistern was supplied with a screw clamp to regulate the flow, which fell in heavy drops.

The wave caused by the drop made contact with the outlet strainer and ejected an equal amount of water while the suction of the falling wave kept the strainer from clogging. The drip was adjusted to renew the water in the flask every four hours, but a faster renewal is possible just so long as the 'make and break' system persists. As tap-water served my purpose, the cistern was kept supplied from a gently running tap, four flasks working from a single main lead, and, provided that air locks were not allowed to form in this lead, the apparatus ran smoothly for an indefinite length of time.

LL. LLOYD.

The University,
Leeds.
Oct. 1.

[1] NATURE, 136, 345, 1935.

X-Ray Examination of the Effect of Removing Non-Cellulosic Constituents from Vegetable Fibres

IN a recent letter by W. T. Astbury, R. D. Preston and A. G. Norman in NATURE of September 7, p. 391, it is stated that "Miles Thomas and Hewitt report a diminished *intensity* in photographs of purified fibres; but we have not observed such an effect".

The results obtained for sisal, in this laboratory, confirm their statement that *no* diminished intensity is observable in photographs of *purified* fibres. On the contrary, the process of purification leads to an improved definition.

Any ambiguity which may have existed on this point is much to be regretted, but it may be easily explained and removed.

Fibres which have been chlorinated by the use of moist chlorine gas, and the so-formed chloro-compounds not removed, were designated "chlorinated fibres". It is these fibres which give a photograph of diminished intensity. There is full agreement as to there being no diminished intensity in photographs of purified fibres.

JOSEPH HEWITT.

Department of Botany,
University College,
Leicester.

Points from Foregoing Letters

CERTAIN strains of mosquitoes (*Culex pipiens*) originally found on the Continent can lay fertile eggs without a previous meal of blood and have been termed 'autogenous'. J. F. Marshall and J. Staley bring evidence that certain man-biting mosquitoes in Great Britain are females of such autogenous strains: they describe the morphological differences between autogenous mosquitoes from various countries and the original non-autogenous variety and suggest that the specific name *C. domesticus* be revived for the autogenous strain.

The original gorilla skulls upon which Richard Owen based his first description of that animal in 1848 have been discovered in the Bristol Museum and Art Gallery. H. Tetley gives their origin and history.

The formation of brown ring deposits on glass by bombardment with positive rays (protons) is reported by Prof. B. Dasannacharya, V. T. Chiplonkar and L. G. Sapre. Similar deposits, but not ring-shaped, have been observed before and ascribed to the decomposition of hydrocarbon impurities.

Dr. R. K. Asundi, M. Jan-Khan and Prof. R. Samuel have increased the small number of completely analysed spectra of polyatomic molecules by an analysis of the SeO_2 bands. They have also analysed the SeO bands, and find a close correspondence between the constants of these two molecules, which indicates strong localisation of the bonds.

The direct measurement of the *L*-series of the X-ray spectrum of the rare gas argon, by means of their new ionic tube, is reported by M. Bačkovský and Prof. V. Dolejšek. The observed values agree well with those calculated by interpolation of the data from Siegbahn and Magnusson.

E. G. Cowley and Prof. J. R. Partington have determined the dielectric constants of several esters of inorganic acids (ethyl and *iso*-amyl borates and triphenyl phosphate) and have calculated their molecular dipole moments.

Experiments by Dr. C. N. Acharya show that, when nitrogenous substances are oxidised by a mixture of chromic and sulphuric acids, the amount of ammonia formed bears a definite proportion to the total nitrogen present, depending on the structure of the compound. Of the residual nitrogen, a part is converted into nitrate, and the rest lost in gaseous form. Dr. Acharya gives the values of 'oxidation constants' for different types of nitrogenous compounds.

If the term 'phoneme' is to be applied to one only of a group of similar sounds then, asks W. F. Twaddell of Prof. Scripture, what name is to be given to the group itself? Further, is there sufficient evidence from sound-track profiles to justify grouping together the *p*'s or *t*'s in such words as '*pit*' and '*tip*'? Prof. Scripture answers that it is a matter of convenience whether the term phoneme is used for a group of similar sounds or for a single member of the group. The essential part, he insists, is that the phoneme shall be defined in quantitative terms based upon film-tracks or similar records, and not upon references to undefinable and unrecorded sounds such as '*t*' in '*tip*'.

In the fermentation of certain sugars to lactic acid. methyl glyoxal is considered to be an intermediary product, it being changed to lactic acid by an enzyme in presence of the sulphur compound, glutathione. From the rate at which lactic acid is produced and from other evidence, J. Giršavičius and P. A. Heyfetz conclude that the glutathione first combines by means of its —SH group with methyl glyoxal, and then, as the enzyme-catalysed reaction develops, enters into a further transformation, again involving its —SH group.

Prof. Neilson Jones directs attention to recent work by Reed and Dufrénoy showing that spraying with zinc sulphate prevents 'mottle leaf' in *Citrus*, and points out that zinc is apparently an essential element in the production of chlorophyll.

Research Items

Recent Cave Exploration in Britain

AT the recent Norwich meeting of the British Association, reports of two committees of Section H (Anthropology) dealt with explorations of caves in Britain which have been subsidised by the Association. Of these, the report on the work carried out in Kent's Cavern, Torquay, indicates that during the past year a stage of excavation has been reached which promises well for future results, though at an enhanced expense. The work of the past year, which was resumed in October, 1934, and continued until the end of May, 1935, was directed to the centre of the Vestibule at the north entrance, which has been the scene of operations of the last three seasons. It proved most remunerative in the quantity and size of the animal relics, among them being the tibia of an Irish elk, believed to be the largest ever found in the cave, a very long rib of a rhinoceros, a well preserved tooth of a mammoth, and the whole of the incisors of a horse. These bones were remarkably free from the gnawing of carnivores. Probably they had dropped between the interstices of the large fragments of rock, with which the floor had then been covered, and thus escaped the further attention of the hyænas by which they had been brought to the cave. In the Creswell Caves of Derbyshire, which have now been under exploration by Mr. A. Leslie Armstrong on behalf of the Association Committee for some years, a section showing the stratification of the deposits in the cave has been prepared for permanent preservation. It is announced that application has been made to the Office of Works for the cave to be preserved and maintained as an ancient monument. In the meantime, Mr. Armstrong has begun work on the deposits at the entrance of the cave, with the view of penetrating to the two Mousterian levels underlying the superficial levels which were all that were examined by the Rev. Magins Mello in 1875. Valuable additions have been made to the fauna and artefacts from Mother Grundy's Parlour. It is now proposed to excavate the Boat House Cave.

Influence of Illumination on Work-Efficiency

A JOINT report of the Industrial Health Research Board and the Illumination Research Committee gives the result of an investigation by H. C. Weston into the relation between illumination and efficiency in work (H.M. Stationery Office, 1935. 4*d*. net). This report describes the first experiment, and deals with the illumination necessary for different sizes of work. Eighteen men were given sheets of paper on which were printed rows of incomplete circles. The gap in each circle pointed a different way, and each of the several sheets had different sized circles and gaps. The men had to cancel the circles in which the gap pointed a certain way. The same tests were given in six different degrees of illumination. Conditions were controlled so that there was no chance of memorising, no violent change in illumination, the minimum fatigue, and full allowance for individual variations. The results were judged according to the speed and accuracy of the subjects' discrimination alone. They show that although the smallest size could never be seen as easily as the largest, the right illumination obtained the maximum performance for each size. A change in size among the smaller and the larger sizes necessitated less alteration in illumination than a change among the intermediate ones. The range of illumination found necessary in the test is easily obtainable in practice.

Adaptation in *Artemia salina*

THE report submitted to Section D at the Norwich meeting of the British Association by the Committee, of which Prof. R. A. Fisher was chairman and Dr. F. Gross secretary, appointed to investigate the progressive adaptation to new conditions in *Artemia salina* (diploid and octoploid, parthenogenetic and bisexual), describes some highly suggestive experiments. Treatment of different races of *Artemia salina* with sodium arsenite showed a considerable difference in susceptibility between the diploid bisexual and the octoploid parthenogenetic forms. Of the latter, several lines showed 100 per cent survival of nauplii, when tested for twenty-four hours at the age of 1–4 days with 0·6 per cent of an $N/10$ solution of sodium arsenite, whereas in the bisexual races even the 50 per cent point of survival lies well under 0·5 per cent poison. In the bisexual races, parallel families showed consistently different degrees of resistance, although, as shown in the report, there were irregularities in the response of different broods of the same parentage, the cause of which has not yet been established. As regards the question whether there was any increase in resistance due to treatment and selection, comparisons were made which indicate in both a parthenogenetic line and in bisexual strains, a higher percentage of surviving nauplii after one and two generations treatment. "In both cases it is difficult to avoid the conclusion that the strength of poison needed to produce a given death-rate has been increased by at least 10 per cent., and probably more for the bisexual material."

Crabs from the Dutch East Indies

DR. ISABELLA GORDON has described in detail a collection of crabs from the Dutch East Indies ("Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique". *Mémoires du Musée royal d'histoire naturelle de Belgique*. Hors Série, 3, Fasc. 15. 1934. Crustacea Brachyura). The material includes several uncommon and interesting forms. The genus *Phymodius* is revised and *P. monticulosus* separated from *P. ungulatus* as a distinct species. The sub-family *Eumedoninae* in the family *Parthenopidae*, and the genus *Xenocarcinus* are also revised. The text-figures in this work are good and, especially in the drawings of the male pleopods, show an extraordinary amount of different types. These male pleopods in many genera are found to be of much specific importance and are a valuable diagnostic character, differing as they do very appreciably in those forms in which they are used for systematic work. Further reports in the same series recently published include the Rhizocephala and the Stomatopod larvæ.

After-Ripening and Germination of Rose Seeds

THE propagation of garden roses by budding good varieties upon stocks raised from seed is likely to find extensive application in the near future. Rose seeds are, however, rather difficult to germinate, but a paper by Dr. M. A. H. Tincker (*Roy. Hort. Soc. J.*, 60, Pt. 9, Sept. 1935) shows that suitable storage conditions before planting will render propagation from seed much easier. Achenes from the rose hips should be scattered in layers in damp sand within a plant pot which is then sunk in ashes in the open. This process is known as 'stratification', and if the seeds remain under these conditions from early November to the beginning of March, subsequent germination is hastened considerably. The paper reports a number of trials of unsuitable methods, the results of which are, nevertheless, illuminating. Storage at low or cool temperatures, for example, did not hasten germination; the seeds apparently require fluctuations in temperature and moisture content such as are provided by stratification.

A Virus Disease of Wallflowers and Stocks

GARDENERS are now familiar with the pathological condition of the tulip known as 'breaking', and it is interesting to note that wallflowers and stocks are subject to a similar malady ("Colour Changes in Wallflowers and Stocks" by Dr. Kenneth Smith, *Gard. Chron.*, 112, Aug. 10, 1935). The cause of the trouble is a virus disease of cauliflower and broccoli. This produces a mottling of diffuse yellow patches on the leaves, and such plants serve as sources of infection for wallflowers and stocks, the aphid *Myzus persicæ* being the transmitting agent. The last-mentioned floral crops have mottling of the leaves, but their flowers are also streaked with white or yellow—a most conspicuous and bizarre effect. Control measures are routine spraying of young plants with a wash to kill the aphids, the destruction of any infected plants, and the separation of the culinary members of the Cruciferæ from the beds with wallflowers and stocks.

Nevada Earthquake of 1934

EARTHQUAKES of moderate intensity are very rarely accompanied by superficial fault-displacements, and thus the account given by Messrs. E. Callaghan and V. P. Gianella of the earthquake of January 30, 1934, in the Excelsior Mountains, is of much interest (*Bull. Amer. Seis. Soc.*, 25, 161; 1935). The shock was of intensity 8 or 9 (modified Mercalli scale) and its epicentre lay in about lat. 38·2° N., long. 118·6° W. Numerous faults traverse the mountain area, and, along one of them on the southern slope and directed N. 66° E., a rupture occurred, about 4,500 ft. in length, with a scarp 5 in. in maximum height, showing that the summit area of the range had subsided with reference to the southern side.

Wind Records in Open Sea

"WIND Records from the Bell Rock Lighthouse", by A. H. R. Goldie, is the title of Geophysical Memoir No. 63 of the Meteorological Office (H.M. Stationery Office. 2*s*. 6*d*.). A Dines anemograph was erected at the Bell Rock in 1929, fourteen feet above the dome of the lighthouse, and 130 ft. above the mean level of the sea; the position, twelve miles from that part of the east coast of Scotland in the neighbourhood of Arbroath, is unique for its representation of open-sea conditions. Nevertheless, the detailed analysis of records obtained in the first two years during which the instrument was working, and their comparison with similar records obtained on the very exposed island of Tiree, suggest that the Scottish mainland is not without its influence on the structure of the wind, even at that distance. The absence for a great distance in all directions of any objects except the sea waves that might cause gustiness by mechanical friction leads one to expect low figures for the 'gustiness'—defined as the difference between the average wind speed in gusts and in lulls divided by the mean speed. The analysis showed that gustiness is greater in winter than in summer, an effect attributed by the author to the greater lapse-rate of temperature in winter. The memoir contains a section dealing with wind waves and squalls which is of particular interest in view of the work done at Cardington on the cell structure of squalls. There appears to be very strong evidence that wave-like fluctuations of wind speed at Bell Rock are nearly always associated with marked horizontal stratification of the atmosphere, while squalls of the type where the wind speed increases very suddenly with a veer of direction and falls off gradually (a feature of the convexional cells found at Cardington) are associated with a steep lapse-rate of temperature.

A Device for Stream Field Study

IN a paper communicated by the Structural Research Laboratory of the Royal Technical College, Copenhagen (Ingeniørvidenskabelige Skrifter. *A*, Na. 39: A New Device for Direct Stream Field Studies and its Application: with an Appendix on the Pressure Distribution on a Triangular Prism. By Paul Neményi. Pp. 23. Copenhagen: G. E. C. Gad. 3.00 kr.), Paul Neményi describes a new device which he has designed for stream field studies, and gives details of its application to the determination of wind pressures on buildings. Recent investigations have shown that with small roof slopes there is a partial vacuum on the windward side, and that when the slope becomes steeper this condition changes somewhat abruptly to pressure. The results obtained from experiments made in the Ahlborn Channel being to an unknown extent influenced by capillary phenomena, it was thought desirable to check and correct these by constructing a closed channel with measuring arrangements to give the direction of the stream, the total velocity pressure and the static pressure. The wind channel is horizontal, and across it is placed a horizontal tube having an almond-shaped section with a single hole in the symmetry axis of the central section. This tube can be raised from bottom to top of the wind channel, and can also be turned through any angle so that the pressure and its direction can be taken at any height in the central plane of the channel. The paper provides an illustration and description of the channel and measuring apparatus, and proceeds to describe a number of typical experiments made on models representing solid and perforated walls and buildings, and on a triangular prism. Diagrams show the pressure distributions obtained in these experiments both in the form of contour maps and cross-sections for various directions of the wind relative to the surfaces. These diagrams exhibit very clearly the surprisingly high negative pressures which occur locally near roof edges. At one point, for example, the negative pressure was found to be 326 per cent of the normal velocity pressure.

Radio Research in Australia

THE Radio Research Board, which was set up some years ago under the Commonwealth of Australia Council for Scientific and Industrial Research, continues to carry out considerable research into several of the fundamental problems of radio communication. The results of some of this work have recently been described in a series of ten scientific papers published in Melbourne in three reports of the Radio Research Board. A foreword to these reports states that the co-operation of several bodies in Australia has greatly assisted the work of the Board. In particular, the Postmaster General's Department contributed half the cost of the investigations during the financial year 1928–29, and three-quarters of this cost in the succeeding years. The Universities of Sydney and Melbourne have provided the necessary laboratory facilities for the location of the staff conducting the work, while the Department of Defence has also assisted with the loan of apparatus and in other ways. It is to be noted that several of the authors of the papers received their early research training in Great Britain with the Radio Research Board organisation under the Department of Scientific and Industrial Research.

The first report of the series under review contains four papers[1], of which one "On the Rotation of the Plane of Polarisation of Long Radio Waves" has been previously published in the *Proceedings of the Royal Society*, 1934. The other three have also been published previously in the *Journal of the Institution of Engineers, Australia*. Two of these papers deal with the development of a radio field intensity measuring set for medium broadcast frequencies, and its use in the exploration of the field around some Australian broadcasting stations. As a result of this work data have been obtained on the effective conductivity of several types of ground, and the resulting attenuation accompanying the propagation of waves over this ground. At the same time, measurements were made on the intensities of indirect or downcoming waves at various distances, and on the general noise level due to atmospheric disturbances, with the view of determining the effective service range of certain broadcasting stations. The last paper in this series describes the development of a frequency recorder for the rapid and continuous measurement of audio frequencies, as required in an extension of the frequency-change method of determining the heights of reflecting layers in the ionosphere.

Report No. 7 contains a group of four papers describing investigations into the propagation of medium frequency electric waves in the ionosphere[2]. Each of these papers has already been published in Great Britain during 1934 or 1935.

The last of the reports[3] so far received contains two hitherto unpublished papers describing the study of atmospherics and their interference effect in radio reception in Australia. The first of these describes a series of observations of the directions and intensities of atmospherics carried out with two visual cathode ray direction-finders installed at the ends of a base line 570 miles long and operating on a wave-length of 3,000 metres. The sites selected for these instruments, at Canberra and Toowoomba respectively, were considered to be particularly suitable for obtaining data on sources of atmospherics in Queensland. With the aid of a short wave radio communication link, simultaneous visual observations were made over a period of four months, December 1933–March 1934. The results are illustrated in the paper by maps showing the distribution of the sources of atmospherics during this summer period, and also lines of equal mean intensity of disturbance produced by each source.

The location of these atmospherics sources shows a very satisfactory correlation with the reports of thunderstorms obtained from the ordinary meteorological records, and thus strongly confirms the previous deduction that the majority of, if not all, atmospherics in Australia originate in lightning flashes. An important inference made by the authors on this portion of the work is that for thunderstorm warnings for aircraft, the cathode ray direction-finder is much preferable to ordinary meteorological methods.

The shapes of the iso-intensity lines referred to above for daytime observations were found to be satisfactorily explained by the effect of the topography of the ground on the propagation of the electric disturbance constituting the atmospheric. After making allowance for this effect, both the day and night observations agree in indicating that all the sources were of the same mean intensity within reasonable limits; in other words, the average power in a particular wave-band radiated by lightning flashes is sensibly constant. The distances at which the sources were located ranged up to about 2,500 miles from the observing stations.

The last paper in this series discusses the effect of atmospheric disturbances on broadcast reception conditions in Australia. The equivalent power of the radiation emitted by an average lightning flash is calculated, and the activity and distribution of lightning flashes in thunderstorms in various parts of Australia has been obtained from the meteorological records. With the aid of these data, the interference of atmospherics with the reception of broadcasting on different wave-lengths and at various field intensities has been calculated. Under the conditions considered in the paper, it is concluded that the proportional time of interference with the normal 4,000 hours of broadcasting per annum is very small. In the foreword to this report (No. 8) it is pointed out that some matters in this paper, such as the standards of reception assumed, may not be generally accepted by other experts on this subject.

[1] A. L. Green and G. Builder: "On the Rotation of the Plane of Polarisation of Long Radio Waves"; A. L. Green and N. B. Wood: "A Field-Intensity Set"; G. H. Munro and A. L. Green: "Measurements of Attenuation, Fading and Interference in South-Eastern Australia at 200 Kilocycles per Second"; D. F. Martyn and H. B. Wood: "A Frequency Recorder". Radio Research Board, Report No. 6, Melbourne 1935.

[2] D. F. Martyn: "The Propagation of Medium Radio Waves in the Ionosphere"; D. F. Martyn and A. L. Green: "The Characteristics of Downcoming Radio Waves"; V. A. Bailey and D. F. Martyn: "The Influence of Electric Waves on the Ionosphere"; D. F. Martyn, R. O. Cherry and A. L. Green: "Long Distance Observations of Radio Waves of Medium Frequencies". Radio Research Board, Report No. 7, Melbourne 1935.

[3] G. H. Munro, H. C. Webster and A. J. Higgs: "Simultaneous Observations of Atmospherics with Cathode Ray Direction-Finders at Toowoomba and Canberra"; W. J. Wark: "Atmospheric Interference with Reception". Radio Research Board, Report No. 8, Melbourne 1935.

National Smoke Abatement Society

MEETING AT BRISTOL

THE annual conference of the National Smoke Abatement Society was held in Bristol on September 20–21 under the presidency of Dr. H. A. de Voeux. Dr. A. G. Ruston summarised the work done with the late Prof. J. B. Cohen on the damage caused by smoke in the West Riding of Yorkshire. Animal, as well as vegetable, life suffers. Land exposed to acid atmosphere becomes deficient in lime, and cows grazing on such land yield milk also deficient in lime.

Dr. R. Lessing reviewed sources of atmospheric pollution, and advocated systematic surveys. The generation of electricity in large units, while diminishing total pollution, has resulted in the localised emission of exceptionally large quantities of acid flue gases, often in thickly populated areas. The concentration of fuel burning has the advantage of facilitating efficient utilisation and also the scientific treatment of the flue gases. Within a few years, two processes have been elaborated for the desulphurisation of flue gases, in the Battersea and Fulham Power Stations. The Fulham process has the advantage of producing no liquid effluent. Dr. Lessing estimates that both processes, when in full operation, will reduce the sulphur acids passed annually into the London atmosphere by 40,000 tons. The London gas companies already recover, during gas purification, sulphur equivalent to 55,000 tons of acid. It may be estimated that the public utilities will eventually recover or remove 20 per cent of the sulphur present in the coal burnt in London.

Large power stations emitting flue gases at a high velocity may be an important source of grit and dust, which is an insidious but noxious polluting agent. Fortunately, the washing process also takes care of the grit and dust at the same time. Central heating of large buildings, institutions, blocks of flats is leading to analogous conditions of local atmospheric pollution on a smaller scale.

Hitherto, efforts to diminish atmospheric pollution have been due mainly to idealists possessing knowledge and vision but impotent to alter actual conditions. Those wielding political power, local and national, have been indifferent. Commercial interests have been passively or actively resistant. Conditions, however, change. Already it is recognised that smoke endangers air traffic, and may render a site ineligible for aerodromes. A recent report of an investigation conducted at Pittsburgh expressed the view that "Smoke is a major obstacle to the popularisation of aviation". Atmospheric pollution is largely responsible for the movement of urban population to the country, and this promotes 'ribbon development'. Smoke may make a district unsuitable or unattractive for new industries. The realisation of this by local authorities and chambers of commerce ought to engender a more active interest in ameliorative measures.

Problems of Administration and Management

PROBLEMS of amalgamation and decentralisation were discussed at Norwich on September 9 by the Department of Industrial Co-operation of the Economic Science and Statistics Section of the British Association. Mr. L. Urwick opened the discussion with a paper on executive decentralisation with functional co-ordination in which he emphasised the necessity for a technical approach to questions of organisation. After discussing the nature of responsibility, and its relation to authority and power, he pointed out that reasons of time and space as well as psychological factors were important influences making for decentralisation. The steady and inevitable growth of functional specialisation made imperative the clear distinction between executive and administrative or policy-making responsibility, as well as the co-ordination of functional methods, and the reconciliation of these two tendencies was the central problem in modern business organisation. Failure to recognise the nature of the difficulty might easily involve the failure of a business combination. When a new duty arose, Mr. Urwick insisted that the only ultimate solution was to define that duty and assign it to individuals, properly selected and suitably trained. He regarded it as inevitable that business organisation should evolve towards a true system of 'staff' positions and relationships as distinct from either 'line' or 'functional' positions, and organised staff training was accordingly essential.

Mr. T. G. Rose described some examples of decentralisation problems in small undertakings, particularly of the management difficulties arising with a head office in London and works in the provinces, or in financial control from London while management and manufacturing activities are carried on in the provinces, or again in the decentralisation of management in a group of rationalised small firms.

Dr. K. G. Fenelon discussed problems of centralisation and decentralisation in the management and administration of combines. A choice between these two alternatives in practice has usually been made on an empirical basis, and frequently following an initial centralisation, a complete reorganisation had been undertaken to achieve decentralisation on a scientific basis. Such a task of reorganisation involves the careful study of each of the different functions and activities and the determination of the most suitable organisation for each. This reorganisation accordingly involves three stages: first the bringing of all the threads into the hands of the central management for the study of the problems and procedure of the different units; secondly, comparative analysis of the varying activities, leading to standard practice; and thirdly, the evolution of a process of decentralisation to give new elasticity.

Dr. Fenelon stressed the extent to which effective decentralisation depended not only on careful study

and preparation but also on getting the personnel to co-operate with one another and to think and act with enthusiasm. Centralisation of administration, that is, control of policies and centralisation of the management of each of the chief functions, did not always in practice go together. Improved management methods had greatly facilitated the centralisation of administrative control, and an economic research department or a statistical department frequently gave specialised assistance. The chief danger of administrative centralisation lies in pushing it to a point at which the initiative of local executives is destroyed and the organisation becomes unresponsive to variations in local conditions and the demands of local markets.

Administration and management, however, cannot be kept entirely distinct. It is essential to provide that a managerial staff shall be consulted in the formulation of policies, their active consent obtained and their interest aroused, and Dr. Fenelon referred to the advantages of the wise use of committees, and a budgetary system. With regard to the control of particular functions, the extent of centralisation or decentralisation should be determined by the nature of the function, and the relative importance of technical knowledge, personal contacts with customers, etc. Considering types of organisation, Dr. Fenelon referred to methods of co-ordination, through a system of committees, and to the use of staff on the lines advocated by Major Urwick. He suggested that in any industry there was a definite size of organisation beyond which smaller returns on capital and organisation were obtained. Moreover, success or failure was often determined by the willingness or otherwise of the chief executives to delegate authority and by the closeness of the attention given to the form of organisation and to the principles of administration.

Fourth Imperial Entomological Conference

THE fourth Imperial Entomological Conference, which was summoned on behalf of the Imperial Institute of Entomology and attended by twenty-seven delegates, each representing a different Dominion, Colony or other area of the British Empire, was held in London on September 19–27. The delegates were received by Sir Charles J. Howell Thomas, chairman of the Executive Council, and devoted the remainder of the first morning to the appointment of committees concerned with questions affecting the future policy and activities of the Imperial Institute of Entomology. Afterwards, four mornings or afternoons were devoted to meetings of committees and a final business meeting, and five to public meetings at which papers were read and discussed. Visits were paid to Rothamsted Experimental Station, the Forest Products Research Laboratory, Princes Risborough, the Parasite Laboratory of the Imperial Institute of Entomology at Farnham Royal, and the Stored Products Research Laboratory, Slough. At Farnham Royal, much interest was taken in a cinematograph film shown by Dr. K. R. S. Morris, illustrating work on the collection in central Europe and Sweden of parasites of pine sawflies (*Diprion*) for export to Canada.

By the courtesy of the president and council of the Royal Entomological Society of London, the public meetings of the Conference were held in the meeting room of the Society at 41 Queen's Gate; the delegates were also given every facility to use the Society's library.

The papers read and discussed were: locusts and grasshoppers, by Dr. B. P. Uvarov; termites, by Mr. F. P. Jepson; cotton-stainers and their control, by Mr. W. Allan; sheep blowflies, by Dr. G. D. Morison; the biological control of insect pests, by Dr. W. R. Thompson; pests of stored products, by Prof. J. W. Munro; the need for forest entomologists, with special reference to the pinhole borer problem, by Dr. R. C. Fisher; and plant viruses and their insect vectors, by Dr. K. M. Smith.

It is impossible here to give even an outline of the contents of all these papers, but mention may be made of two, selected as typical examples. That by Mr. Jepson attracted great interest, as it was realised that it dealt with problems on the practical aspects of which much work is required and relatively little has been done. Authorities on termites are few, and most of them are primarily interested in the systematic branch of the subject. Mr. Jepson opened by indicating the enormous damage caused by termites to crops, forest trees and all structures in which timber is employed in the tropics and subtropics, and estimated the annual losses as several millions of pounds sterling in the Empire alone. He then devoted the main part of his paper to a very valuable account of the methods found effective in his experience for the construction of buildings of various types in order to render them proof against invasion by soil-nesting termites, the principle underlying all of them being the insertion between the superstructure and the soil of a barrier of concrete that the insects cannot pass through or round. In his experience (and this was confirmed by speakers in the discussion that followed), Government engineers are usually not inclined to welcome advice on the construction of termite-proof buildings, and great damage to or destruction of valuable buildings constantly results. In addition to excluding subterranean termites, however, it is further necessary, in many countries, to guard against the establishment of drywood termites in the timber of buildings. As these gain admittance in the winged state, the only solution is to use timber that is naturally immune or has been rendered so by artificial treatment. Owing to the contamination of food by the fæcal pellets of these insects, which occurs when they infest roof-timbers, food-safes, etc., the varied protozoan and bacterial fauna of their intestines deserves further study. In Ceylon, it is usually in houses attacked by them that cases of sprue develop, and there is reason for suspecting that the contamination of human food by their solid excrement is in some manner associated with the causation of this disease.

As a result of this paper and the discussion that

followed, a Committee on Termites was appointed, and the Conference adopted consequent resolutions in which it emphasised the heavy losses caused by termites and the lack of knowledge on them, and recommended the accumulation of data on the financial losses to buildings, agriculture and the forest industry, the identity and habits of the species involved, and methods of control. It also recommended that this matter be taken up with the Governments concerned with the view of providing for a thorough investigation of the whole problem.

In contrast to the above, Dr. Uvarov's paper was a report of progress on a subject on which a large amount of co-ordinated study has been carried on for several years. The possibility of preventing outbreaks of locusts is based on the fact that the swarming phase is produced from the solitary one under certain peculiar combinations of external conditions that occur at times in definite and relatively restricted areas. Once it is produced, the swarms spread over immense regions, and the invasion develops in spite of all efforts to stem it. As a result of the extensive international organisation of which the Imperial Institute of Entomology is the centre, records of the movements and breeding of swarms over the infested area of Africa and south-western Asia are analysed, and from the data thus obtained field investigations are made to locate the centres in which the outbreaks arise, with the view of studying the ecological factors concerned in their commencement and the possibility of preventing it. It has thus been shown that the recent outbreak of the tropical migratory locust, which spread gradually over the greater part of Africa, originated in one or two restricted areas on the Middle Niger, and that the red locust similarly originated in a very few areas in Northern Rhodesia and Tanganyika Territory. Work on the desert locust has not progressed so far, but outbreak centres have been discovered on the coasts of the Sudan and of Baluchistan, and it is almost certain that none exists in the inner deserts of Africa. It will therefore be seen that the international investigations have provided a foundation for a preventive anti-locust policy, by which the outbreak centres can be kept under supervision and incipient outbreaks suppressed.

The discussion that followed afforded evidence that similar outbreak centres are characteristic of the principal injurious grasshoppers of North America and Australia.

Timber in the Box-Making and Coal-Mining Industries*

IN 1931, the Forestry Commissioners appointed an Inter-Departmental Committee to inquire into the possibility of making better use of the timber supplies of Great Britain. An interim report was submitted by this Committee in 1933, and recommended a series of detailed inquiries into the demand for timber for certain specific purposes. A first report dealt with the demand for timber for box and packing-case manufacture in Great Britain, whilst a second, now before us, deals with the demand for timber in coal-mining in England and Wales.

In the first report it was stated that there were two distinct sections of the industry, the box and packing-case makers on one hand, and the shook-using firms who merely assemble the component parts of the boxes already prepared, on the other.

So far as was observed, the timber used for shooks is invariably imported, and there was no evidence that home-grown timber could economically take its place either in character or quality. In the box and packing-case industry, home-grown timber, chiefly spruce and fir, is being extensively used in Scotland, and its suitability for many kinds of boxes is widely admitted in other areas, subject to various provisos. The Scottish firms are using it for mineral-water boxes and beer boxes, for the larger and heavier sizes of fish boxes, for soap boxes, for machinery cases, and cases for shipping rope and generally for any type of box in which light weight and a specially dressed appearance are not essential.

"The fact," says the report, "that, within the limits of the present enquiry, 20 per cent of the timber used by box making firms throughout Scotland, and over 40% of the timber used by those in Aberdeen, is home-grown, is emphatic evidence that home-grown timber could be used more largely than it is in other areas if adequate supplies were available in good condition, and if the cost of transport did not make the price prohibitive." Even in Scotland, a number of criticisms of home-grown timber were made. Perhaps the chief, which certainly restricts its use for the finer and lighter types of packing-cases, is the question of the excessive quantity and size of the knots. The presence or absence of knots in home-grown or any other timber is purely a question of good sylviculture, which, with properly grown and tended plantations, should right itself in the future.

With the interest of the State in afforestation schemes during the past fifteen years, and the creation of State plantations extending to more than 250,000 acres, and with another 100,000 acres of privately owned woods, it is obviously desirable that outlets should be found to absorb the increasing supplies of material which will become available.

In the report on the demand for timber in coal-mining, the report shows that the cost of mining timber annually consumed in Great Britain is about £6,000,000, and represents approximately a cost of 7*d*. on every ton of coal put on the market. Of this quantity, some 2¼ million loads were imported in 1934. It is said that an increase in the proportion supplied from native sources is possible immediately, and it can be substantially supplemented in the future from plantations at present immature.

The chief need is an effective scheme for marketing the home-grown supplies, and steps towards the attainment of this end have been taken in the formation of a Home-grown Timber Marketing Association under the chairmanship of Lord Clinton.

* Forestry Commission. Report on the Demand for Timber for Box and Packing-Case Manufacture in Great Britain. Pp. 47. (London: H.M. Stationery Office, 1934.) 9*d*. net.

Forestry Commission. Utilization Series, No. 2: Report on the Demand for Timber in Coal-Mining in England and Wales. Pp. vi+77. (London: H.M. Stationery Office, 1935.) 1*s*. 3*d*. net

Educational Topics and Events

CAMBRIDGE.—Dr. J. A. Ryle has been appointed regius professor of physic in succession to Sir. W. Langdon Brown, who retired on September 30.

At Trinity College, H. Cary Gilson, N. M. V. Rothschild and H. W. Melville have been elected to fellowships.

At Pembroke College, Dr. G. B. B. M. Sutherland has been elected to a fellowship and appointed lecturer and director of studies in physical sciences.

GLASGOW.—The King has been pleased to approve the appointment of Dr. Edward Hindle to be regius professor of zoology in the University of Glasgow, in succession to Prof. John Graham Kerr, who has resigned.

OXFORD.—Prof. H. S. Jennings, professor of zoology and director of the zoological laboratories at Johns Hopkins University since 1910, has succeeded Dr. A. H. Compton of Chicago as George Eastman visiting professor and fellow of Balliol College. Prof. Jennings is an authority on the behaviour of lower organisms and on genetics.

Prof. G. H. Hardy of Cambridge has been elected an honorary fellow of New College, of which for many years he was a fellow.

Mr. B. V. Rollin (in physics) and Mr. G. J. Whitrow (in mathematics) have been elected to Harmsworth senior scholarships at Merton College.

Science News a Century Ago

H.M.S. *Beagle* Crosses the Pacific

UNDER the date October 20, 1835, Darwin records: "The survey of the Galapagos Archipelago being concluded, we steered towards Tahiti and commenced our long passage of 3,200 miles". He says that, during the voyage, "We passed through the Low or Dangerous Archipelago, and saw several of those most curious rings of coral land, just rising above the water's edge, which have been called Lagoon Islands. A long and brilliantly-white beach is capped by a margin of green vegetation; and the strip looking either way, rapidly narrows away in the distance, and sinks beneath the horizon. From the mast-head a wide expanse of smooth water can be seen within the ring. These low hollow coral islands bear no proportion to the vast ocean out of which they abruptly rise; and it seems wonderful, that such weak invaders are not overwhelmed by the all-powerful and never-tiring waves of that great sea, miscalled the Pacific."

The Horticultural Society

A MEETING of the Horticultural Society took place on October 20, 1835, in the rooms of the Society in Regent Street. "The tables which are usually covered with a gorgeous profusion of rare and beautiful shrubs and plants," said *The Times*, "presented an unexpected wintry meagreness of appearance. The Secretary explained that the severe frosts of the previous two nights had materially interfered with the intended display, the thermometers suspended against the walls of the Society's gardens at Chiswick had, on both nights, been as low as 27 of Fahrenheit. . . . There were a few exotic plants, principally from the gardens of Mr. Rolleson, of Tooting. . . . From the Society's gardens was a stove plant of the Orchideous tribe, which was deemed a great curiosity. It was a native of Surinam and was almost unknown in this country. The flower petals were of a dark colour, and the more closely examined, the more beautiful appeared their markings. They had an agreeable fragrance, somewhat partaking of the combined odours of the moss rose and the honeysuckle. . . . From a nobleman's grounds at Catterick, in Yorkshire, had been sent a plate of the veritable old English golden pippin, as a proof that the species was not, as generally supposed, extinct."

Sir James South and Christ's Hospital Boys

THOUGH among many of his contemporaries Sir James South (1785–1867) was perhaps as well known for his litigious character as for his astronomical work at Campden Hill, a kindly act of his was the subject of a letter from "Præceptor" in *The Times* of October 22, 1835. "On Tuesday last," the writer said, "Sir James South invited 50 of the scholars of Christ's Hospital, together with the masters and officials of the establishment, to view the comet at his observatory at Kensington. The evening proving unfavourable for the purpose, Sir James devoted the time to an explanation of his various instruments of observation . . . and afterwards set his youthful auditors to give each a practical proof of his attention to what he had heard, with the results of which he expressed himself very much pleased. He then treated them with a plentiful supper, and on their departure gave them another invitation, that they might not be disappointed of their view of the comet." A second visit was paid next day, the comet was seen and Sir James South in his drawing room delivered a lecture "on the methods by which individuals, however humble, may overcome the early difficulties that may obstruct their path in the attainment of scientific knowledge. . . ."

Lyell, Agassiz and Deshayes

IN the course of a long letter to Sedgwick, Lyell on October 25, 1835, said of Agassiz: "His knowledge of natural history surprises me the more I know of him, and he has that love of imparting it, and the power of doing it with clearness, which makes one feel one is getting on, and that one has caught his enthusiasm. I feel this also strongly when in company with Deshayes, who continues steadily to cultivate his own branch, and that under somewhat discouraging circumstances. . . . As it is my wish to propose the Wollaston medal this year to Deshayes, I wish you would have a talk with Agassiz when he is with you about the matter, for I believe there is no one in London who has seen so much of Deshayes, and knows so well his acquirements and the difficulties he has over-come as Agassiz. I am sure that if we could draw Deshayes over here, he would make a grand reform in our Museums, like Agassiz, and that he would discover rich mines of hidden treasure. . . ." G. P. Deshayes (1797–1875) at this time was teaching privately and devoting his leisure to zoological and conchological studies. From 1839 until 1842 he lived in Algeria. After his return he gave private courses on geology and palæontology and in 1869 was appointed to a chair in the Muséum d'Histoire Naturelle. The Wollaston Medal of the Geological Society of London was awarded to him in 1870.

Societies and Academies

BRUSSELS

Royal Academy of Sciences (*Bull. Classe Sci.*, 21, No. 7, July 1935). P. BURNIAT: A normal surface of bigenus one in linear space of four dimensions. O. ROZET: Surfaces of coincidence. O. ROZET: The canonical pencil of a surface. ST. GOLAB: The rectifiability of curves in contro-affine plane geometry. YVONNE DUPONT: Th. De Donder's thermodynamic synthesis applied to the transverse Nernst and Ettingshausen effects (3). Bridgman's relation is deduced without using the unnecessarily restricted hypothesis of previous papers. J. L. DESTOUCHES: Operatorial kinetics. B. ROSEN and M. DÉSIRANT: Researches on the molecular spectrum of selenium vapour (2). The paper discusses the $^1\Sigma \rightarrow {}^1\Sigma$ band system and its fluctuations and deduces the value 1·9 volts for the energy of dissociation of the Se_2 molecule. M. H. WUYTS and MISS A. LACOURT: A new synthesis of sulphur derivatives of indol. A sulphur derivative of indol was obtained by the action of hydrochloric acid in methyl alcohol on methylthiohydrazide. L. VERLAINE: The analytical character of perception in the macaque. Experimental methods and the precautions necessary in investigating the sense of perception in this monkey are discussed. R. VANDERWALLE: Contribution to the study of the mechanism of the action of heat in anti-smut disinfection of the seeds of cereals. A critical discussion of suggested explanations and a description of inoculation experiments with a micromanipulator.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, October 20

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Mammals".*

Monday, October 21

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—M. Burton: "Bahamas Sponge Fishery".*

Tuesday, October 22

EUGENICS SOCIETY, at 5.15.—(in the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—H. Brewer: "Eutelegenesis—Objections and Criticisms Considered".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Pol Gerard: "Comparative Histo-Physiology of the Vertebrate Nephron" (succeeding lectures on October 24 and 25).*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Sir James Jeans.*

Wednesday, October 23

ROYAL SOCIETY OF MEDICINE (SECTION OF COMPARATIVE MEDICINE), at 5.—Prof. J. C. G. Ledingham: "The Comparative Study of Clinically Allied Viruses: some unsolved Problems of Edward Jenner" (Presidential Address).

Thursday, October 24

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. M. Kennedy: Inaugural Address.

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Sir William Bragg.*

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (TEES-SIDE BRANCH), at 7.30—(at the Cleveland Scientific and Technical Institution, Middlesbrough).—Address by P. A. R. Leith (chairman).

Chr. F. Christensen: "By Air and Sea to the Antarctic Whaling Grounds" (Cinematograph Film).

Friday, October 25

GEOPHYSICAL MEETING (ROYAL ASTRONOMICAL SOCIETY), at 4 30.—Discussion on "Geodesy in India" to be opened by Capt. G. Bomford. Speakers: Sir Gerald Lenox-Conyngham, G. H. Tipper and Dr. J. de Graaff Hunter.

KING'S COLLEGE, LONDON, at 5.30.—Dr. Paul Dienes: "Intuitionist Logic and the Foundations of Mathematics" (succeeding lectures on November 1 and 8).*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Colonel A. E Davidson: Presidential Address.

INSTITUTION OF CHEMICAL ENGINEERS, at 6 30.—Sir Harold Hartley: "Our National Coal Resources" (Second Hinchley Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (SECTION OF EPIDEMIOLOGY AND STATE MEDICINE), at 8.15.—Surgeon-Capt. S. F. Dudley: "On the Biological Approach to the Study of Epidemiology" (Presidential Address).

Official Publications Received

Great Britain and Ireland

League of Nations: International Committee on Intellectual Co-operation Report of the Committee on the Work of its Seventeenth Plenary Session. (C. 290 M. 154) Pp. 63. (London. George Allen and Unwin, Ltd) 2*s*. 6*d*

The Royal Technical College, Glasgow. Calendar for the One Hundred and Fortieth Session, 1935-1936. Pp 476+xxiv. (Glasgow: Royal Technical College.)

Education in 1934: Being the Report of the Board of Education and the Statistics of Public Education for England and Wales (Cmd 4968) Pp xiii+217 (London. H.M. Stationery Office.) 3*s* 6*d* net.

The British Science Guild. The Alexander Pedler Lecture, 1935 Antarctic Exploration Past and Present. By Commander L. C Bernacchi. Delivered under the auspices of the Geographical Association in Manchester on 22nd March 1935. Pp 20. (London: British Science Guild.) 1*s*.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1934 Part 1, with Report of the Geological Survey Board and Report of the Director. Pp iv+85. (London: H M. Stationery Office) 1*s*. 6*d*. net.

London Shellac Research Bureau. Technical Paper No. 4: Fundamental Physical Properties of Lac Part 2 Thermal Properties. By Dr. Lal C. Verman Pp 20. Technical Paper No. 5: Direct Liquid Extraction Process for Pure Lac Resin. By Dr Lal C Verman and Dr. R. Bhattacharya. Pp. 32. (London London Shellac Research Bureau.)

The Royal Society of Arts Cantor Lectures: Modern Spectroscopy A Series of Lectures given before the Royal Society of Arts, November and December 1934, by Prof. Herbert Dingle. Pp. 47. (London Royal Society of Arts.) 2*s* 6*d*.

Eton College Natural History Society. Annual Report, 1934-35. Pp. 38+5 plates. (Eton. Eton College) 2*s*. 6*d*.

Philosophical Transactions of the Royal Society of London. A746 A Photographic Investigation of Flame Movements in Gaseous Explosions 7: The Phenomenon of Spin in Detonation. By Prof. William A Bone, Reginald P. Fraser and Dr William H. Wheeler. Pp. 29-68+plates 2-12. (London: Harrison and Sons, Ltd.)

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Period ended 31st March 1935. Pp. ix+133+14 plates. (London H.M Stationery Office) 3*s*. net.

Air Raid Precautions. Handbook No. 7. Anti-Gas Precautions for Merchant Shipping. (Issued by the Home Office, Air Raid Precautions Department) Pp. 41 (London: H M. Stationery Office.) 3*d* net.

The National Physical Laboratory. Collected Researches Vol. 25, 1935: Metallurgy. Pp. v+432+68 plates. (London: H.M Stationery Office.) 25*s* net

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1935; with Appendices. Pp 48. (London H.M. Stationery Office) 9*d* net.

North British Association of Gas Managers. Half a Century of Combustion Research (The William Young Memorial Lecture, 1935.) By Prof. William A. Bone. Pp. 24. (St. Andrews: North British Association of Gas Managers.)

The British Academy. Presidential Address, July 1935 By J. W. Mackail (From the *Proceedings of the British Academy*, Vol. 21) Pp. 11. (London. Oxford University Press) 1*s*. net.

International Tin Research and Development Council Bulletin No. 2 Solder. Pp. 54 Technical Publication, Series A, No. 21: Examination of the Surface of Tinplate by an Optical Method. By W. E. Hoare and Dr. Bruce Chalmers. Pp. 8+1 plate. (London: International Tin Research and Development Council.) Free

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1625 (T. 3533) Pressure Distribution on Wings with Ailerons. By W. L. Cowley and G. A. McMillan. Pp 73+20 plates. 3s. 6d. net. No. 1641 (T. 3570): Cooling of an Air-Jacketed Engine By A. S. Hartshorn. Pp 55+17 plates. 3s. 6d. net No. 1658 (Strut. 183): Abstract—A New Surface Extensometer By T. W. K. Clarke. Pp. 2 2d net. (London: H M. Stationery Office.)

Final Report (July 1935) of the Furunculosis Committee appointed July 1929 by the Rt. Hon. William Adamson and the Rt. Hon. Noel Buxton. Pp. 67. (London: H.M Stationery Office.) 2s. 6d. net.

University of London. School of Librarianship at University College: Session 1935–1936. Pp. ii+321–334+12. (London: University College.)

Ministry of Health. Housing: Summary of the Principal Provisions of the Housing Acts and Public Health Acts in relation to the maintenance of Dwelling-Houses in a reasonably Fit Condition for Human Habitation. (Revised) Pp. 8. (London: H.M. Stationery Office.) 2d. net.

Birkbeck College (University of London) Calendar for the Year 1935–1936 (113th Session). Pp. 268. (London: Birkbeck College)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 20: Ordovician Submarine Disturbances in the Girvan District. By Dr. S. M. K. Henderson. Pp. 487–509+4 plates. 4s 6d. Vol. 58, Part 2, No 21: The Geology of St. Kilda. By Dr A. M. Cockburn. Pp. 511–547+5 plates. 6s. 6d. Vol. 58, Part 2, No. 22: Further Observations on the Genus *Lyginorachis* Kidston. By Dr Mary G. Calder. Pp. 549–559+2 plates. 2s. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1656 (S. 209): Effect of Wing Setting on Water Performance of Seaplanes. By W. G. A. Perring Pp. 8+3 plates. 9d. net. No. 1661 (Int. 125): Expanding Passages on Aircraft. By F. B. Bradfield. Pp. 5+1 plate. 6d. net. No. 1663 (Spin. 210): Air Density Effect in Spinning. By S B. Gates and A. V. Stephens. Pp. 7+4 plates. 9d. net. (London: H.M. Stationery Office.)

Other Countries

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1934 to March 1935. Pp ii+12 (Accra: Government Printer; London: Crown Agents for the Colonies) 2s.

The Rubber Research Institute of Malaya. Annual Report, 1934. Pp. ii+175 (Kuala Lumpur: Rubber Research Institute.) 1 dollar.

Bergens Museums Årbok, 1935. Naturvidenskapelig rekke, Nr. 1: Om *Arenaria humifusa* Wg og dens betydning for utforskningen av Skandinavias eldste floraelement. Av Rolf Nordhagen. Pp. ii+183+11 plates. (Bergen: Bergens Museum)

Tanganyika Territory Department of Geological Survey. Annual Report, 1934. Pp. 61. (Dar es Salaam: Government Printer.) 2s 6d.

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 8. Protection below Khanki Weir. By J. P. Gunn. Pp. 9+8 plates. 4 annas; 5d. Research Publication, Vol. 2, No. 9. Influence of an Upstream Sheet Pile on the Uplift Pressure on a Floor. By Dr. N. K Bose and Harbans Lal Uppal. Pp. 62+11 plates. 1 4 rupees; 1s 11d (Lahore: Government Printing Office)

Census of India, 1931. Vol. 1: India. Part 3: Ethnographical. A: Racial Affinities of the Peoples of India, by Dr. B. S Guha, B: Ethnographic Notes by various Authors, edited by J. H. Hutton. Pp. lxii+245+39 plates. (Delhi. Manager of Publications) 7.10 rupees; 13s

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 3: Beiträge zur Geometrie der Kreise und Kugeln, 11. Von Sôji Matsumura Pp 87–112 Vol 15, No. 4: Über Flachen und Kurven, 9. Von Sôji Matsumura. Pp. 113–130. Vol. 15, No 5: Beitrage zur Geometrie der Kreise und Kugeln, 12; Über Flächen und Kurven, 10; Über Parameter der ebenen Kurven. Von Sôji Matsumura. Pp. 131–164 Vol 15, No. 7. Über Flachen und Kurven, 11; Zur relativen und naturlichen Geometrie. Von Sôji Matsumura Pp. 171–180. Vol. 15, No. 9: Über Flächen und Kurven, 12; Über Flächen und Kurven, 13; Beitrage zur Geometrie der Kreise und Kugeln, 13. Von Sôji Matsumura Pp. 193–243. (Taihoku: Taihoku Imperial University.)

Royal Agricultural Society, Egypt. Bulletin No. 22 of Technical Section and No. 1 of Royal Agricultural Society and Imperial Chemical Industries, Ltd Joint Agricultural Research Scheme: Experiments in Egypt on the Interaction of Factors in Crop Growth. 1: A Preliminary Investigation of the Interrelation of Variety, Spacing, Nitrogen and Water Supply, with Reference to Yields of Cotton. By Frank Crowther and Ahmed Mahmoud. Pp. 34. (Cairo Royal Agricultural Society.)

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 6: Investigation of the Root-System of Sugarcane Varieties. By Dr. H Evans. Pp. 44+47 plates. (Port Louis: Government Printer.)

Department of Commerce and Industries: Fisheries and Marine Biological Survey Division Fishery Bulletin No. 1: The Natural History and Utilization of the Cape Crawfish, Kreef or Spiny Lobster, Jasus (*Palinurus*) lalandii (Milne Edwards) Ortmann. By Cecil Von Bonde and J. M. Marchand Pp. 55+17 plates. (Pretoria: Government Printer.) 1s.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 125: On Shock-Absorption by the Oleo Undercarriage. By Taitiro Ogawa and Yosiro Murata. Pp. 125–193. 90 sen. No. 126: The Wall Interference of Wind Tunnels with Boundaries of Circular Arcs. By Kazuo Kondo. Pp. 195–262. 65 sen. No. 127: On a Problem of Heat Convection with special reference to the Theoretical Explanation of Schmidt's Experiment. By Tatudirô Sasaki. Pp 263–279. 20 sen (Tôkyô. Kôgyô Tosho Kabushiki Kaisha.)

Sveriges Geologiska Undersökning Ser C, No. 375: Tjälbildningen och Tjällyftningen med särskild hänsyn till vägar och järnvägar. Av Gunnar Beskow. With an English Summary. Soil Freezing and Frost Heaving. Pp. 242. 5 kr. Ser. C. No. 384: Sambandet mellan moräntyper samt bestånds- och skogstyper i Västerbottens lappmarker. Av Eric Granlund och Sten Wennerholm. Pp 65 2 kr. Ser. C, No. 385: Die Mollusken und Brachiopoden der schwedischen Kreide. 2: Kullemölla, Lyckås, Käseberga und Gräsryd. Von Richard Hagg. Pp. 94+10 plates. 2 kr. Ser. C, No. 386: Die stratigraphischen Ergebnisse des Tiefbohrung bei Kullemolla im sudostlichen Schonen. Vorläufiger Bericht. Von Alf Lundegren. Pp. 18+1 plate. 1 kr. Ser. C, No. 387: Stratigrafien inom södra Lapplands kvartärt-sparagmitbildningar i Långseleåns och Korpåns dalgång. Av Bror Asklund. Pp. 58+1 plate. 2 kr. Ser. C, No. 388: Stratigrafiska och tektoniska studier inom Follingeområdet i Jamtland. Av Per Thorslund och Bror Asklund With an English Summary: Stratigraphical and Tectonical Studies in the Follinge Area in Jemtland. Pp 61+3 plates. 2 kr. Årsberättelse for år 1932. Pp. 9. 0 50 kr. Årsberättelse för år 1934. Pp. 9. 0.50 kr. (Stockholm: P. A. Norstedt and Soner.)

Publications of the Astronomical Institute of the University of Amsterdam. No 4: The Theoretical Intensities of Absorption Lines in Stellar Spectra. By A. Pannekoek. Pp. 74. (Amsterdam: Astronomical Institute)

U.S. Department of Agriculture. Technical Bulletin No. 478 The Use of Carbon Disulphide against the Japanese Beetle. By W. E. Fleming and F. E. Baker. Pp 92. (Washington, D.C.: Government Printing Office.) 10 cents.

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Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1934. (No. 747.) Pp. iii+209. A Study of Clay Winning and its Costs in the Provinces of Ontario and Quebec. By J. F. McMahon. (No 754.) Pp iv+90. 25 cents. (Ottawa: King's Printer)

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Obras completas y Correspondencia cientifica de Florentino Ameghino. Vol. 17: El tetraprothomo y el diprothomo Edición oficial ordenada por el Gobierno de la provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 707+57 plates. (La Plata.)

Summary Proceedings of the Thirtieth Meeting of the Indian Central Cotton Committee, Bombay, held on the 4th and 5th February 1935. Pp. 114. (Bombay: Indian Central Cotton Committee.)

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Laboratory Apparatus for the Milling, Baking, Grain, Seed and Allied Trades. (List No. M. 105.) Pp. 88. (London: A. Gallenkamp and Co, Ltd.)

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The Newton Projection Microscope Pp 11. (London: Newton and Co.)

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Bridging the Gap: a Brief Outline of some of the Activities of the Research Organisation of Metropolitan-Vickers Electrical Co., Ltd Pp. 48. (Manchester: Metropolitan-Vickers Electrical Co., Ltd.)

Stains, Chemicals and Reagents. (Catalogue S) Pp. 40. (Manchester: Flatters and Garnett, Ltd.)

High Tension Rectification: introducing Philips Gasfilled Rectifying Valve. Pp. 48. (London: Philips Lamps, Ltd)

Selected List of Publishers' Remainders: being New Books offered at Greatly Reduced Prices. (Catalogue No. 593.) Pp. 26. (London: Francis Edwards, Ltd.)

Classified List of Second-hand Scientific Instruments. (No. 108) Pp. vi+58 (London: C. Baker.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3443 SATURDAY, OCTOBER 26, 1935 Vol. 136

Food Supplies and Health

THIS paradoxical situation, poverty in the midst of plenty, presents a problem the solution of which has proved beyond the power of individual national policies. A more equitable distribution of foodstuffs and renewed prosperity in the farming industry can only be secured by far-sighted co-operative planning on a world scale.

At the League of Nations Assembly in September, Mr. Bruce, speaking for the Australian Delegation, suggested combining the studies of national health and agricultural economics, in the belief that a practical treatment of the one question may help to solve the other. Delegates from twelve countries asked that an international inquiry into the relation of health to nutrition and their bearing on agricultural problems might be discussed by the present Assembly. On behalf of the Government of the United Kingdom, Lord De La Warr welcomed these proposals and looked forward to fashioning practical schemes which will turn increased powers of production into a blessing instead of a disaster and make possible a healthier and fuller life. The adjustment needed is the extension of consumption and not the restriction of output.

Every country has tried to stave off the ruin of its farmers, and some of the emergency measures adopted in self-defence have cut two ways. Restricted imports at first forced up the prices of home produce, but by reducing consumption in the long run reacted adversely on the farmer. Everyone prefers home produce if able to afford it. The extent to which lowered prices increase consumption has recently been demonstrated by two interesting experiments. By issuing vouchers to the unemployed, who formed one third of the population in a Durham town, the Potato Marketing Board effected a price reduction equivalent to 3*d*. a stone, and the total consumption of potatoes in the district increased by ninety-six per cent. Through another Government-aided scheme, the price of milk to school children was halved and within nine months the consumption was trebled. The price of meat might be lowered if it became customary in Great Britain, as on the Continent and in the United States, to market veal and 'baby beef' in place of old and costly fat-stock.

By judicious controlling of prices, the current of popular demand can be diverted towards the purchase of the right kinds of foods more surely and quickly than by any educational process. The artificial stimulation of the consumption of such foods as potatoes, milk and milk products, fish, eggs, fresh fruit and vegetables, will repay in health the money expended and may eventually pay in cash. It is good to read in a memorandum just issued by the Ministry of Agriculture and Fisheries that the wisdom of having spent millions on subsidising production is now questioned, and the financing of price cuts advocated as an alternative likely to pay a dividend in improved national health with less drain on the taxpayer.

From the point of view of nutrition, subsidies for sugar and wheat are unnecessary. Both these foodstuffs were already consumed in sufficient amounts and cannot be produced economically in Great Britain. For health reasons also, the growing consumption of sugar is to be deprecated. A subsidy might more profitably be devoted to the distribution of basic manures for those soured fields which produce nothing but fine crops of sorrel and daisies.

We look forward to the realisation of Mr. Bruce's ideal, the marriage of health and agriculture. At present there is no unity of action. Municipal sanitarians project ever larger and more expensive schemes for swilling wastefully into the sea the

precious mineral salts and organic matter, which, by the appropriate treatment of sewage, could be conserved and used to restore fertility to exhausted soil.

Foodstuffs are the material of which mankind is built, and cannot be viewed dispassionately as purely commercial commodities. An international committee might consider the bill-of-fare which each country can produce and advise how its deficiencies can best be supplemented in the promotion of health by suitable imports. The effect upon land-locked countries of a reduced import of sea-fish and fish-liver oils is now visible in the prevalence of goitre and rickets in Central Europe. Curtailed importations of citrous fruits, tomatoes, etc., may also prove harmful to health in wintertime.

The extent to which malnutrition exists cannot be assessed in the absence of a proper standard. The figures returned present obvious absurdities; a relatively prosperous borough like Twickenham claiming a malnutrition rate about six times as high as that of Wigan; and Bootle a rate twelve times as high as Liverpool, of which it is an extension. The immediate task is to create a higher standard of life in terms of health and proper food.

The Warburg Institute

Kulturwissenschaftliche Bibliographie zum Nachleben der Antike
Band 1: Die Erscheinungen des Jahres 1931. In Gemeinschaft mit fachgenossen Bearbeitet von Hans Meier, Richard Newald, Edgar Wind. Herausgegeben von der Bibliothek Warburg. (A Bibliography on the Survival of the Classics. First Volume: The Publications of 1931. The Text of the German edition with an English Introduction. Edited by the Warburg Institute.) Pp. xxiii+333. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1934.) 21*s*. net.

FOUNDED at Hamburg by a wealthy Jewish family who had made a fortune in America, and inspired by Prof. Warburg of that stock, the Warburg Institute has within the last two years been transferred to the banks of the Thames, and now takes rank with the numerous benefactions which our more tolerant nation owes to foreign persecutions. It consists of a rich and specialist library, well arranged in part of Thames House on the Embankment, near the new Lambeth bridge. The volume under review is the first issued from the Institute's new headquarters, and is for the first time introduced by a full and interesting English chapter, giving the general object of the Institute and the general scope of this issue. Both the volume and the Institute deserve the notice and the encouragement of readers of NATURE, because, though starting with a literary tradition, they offer promise of providing in England a more adequate library for the study of the history of civilisation (including, and based on, science) than can be found elsewhere. There is in fact no such collection of books anywhere available to the public, though a few private collectors, such as Dr. Merz at Newcastle-on-Tyne, have been inspired by the idea.

This *catalog raisonné* of more than 300 pages purports to be an account of only the books published in the year 1931, though, as the dates are not given after the separate entries, it is impossible to satisfy one's self on that score, and no doubt many are included which had appeared by then, though not exactly in that year. The editors explain in their introduction that their general ideal is that of promoting the study of the history of *Cultur*, and quote Burckhardt as the fountain-head. The notion has, however, been enlarged in one direction and narrowed in another, since Burckhardt's time, in the programme of the Institute, and this the editors attribute to Prof. Warburg himself. The 'culture' studied is not civilisation as a whole, but 'culture' as represented in the West by the tradition of Greece and Rome. But, while thus limited in extent, it became deeper in content by the inclusion of all forms of tradition in western Europe. Thus folk-lore and magic are included, as well as the æsthetic ideals which appealed to Burckhardt and the earlier students of the art of the Renaissance. Warburg refused to separate literary from artistic or religious documents, on the ground that the student who seeks to understand how the Olympian gods were revived in the Renaissance as æsthetic ideals must also study how they survived in the Middle Ages as astrological and magical demons.

The bulk of the volume is in German, and one can only indicate here in the briefest way the riches of its content. The survival of the classical tradition is discussed, first, in a general way—what does survival in this sense mean, and then, under

its separate sections, of religion, mythology, philosophy and the various sciences. A large section is devoted to the artistic tradition, both in the theatre and in the plastic arts. A similar division covers speech and music. Rather more than a third of the whole treats of the classical tradition, as it was displayed in particular epochs and regions. Thus both the Hellenistic West and Hellenistic Judaism are fully dealt with, and one passes through the transformations of Byzantium and the Middle Ages, down to the more fragmentary and slighter treatment accorded to the humanism of the present. On this last section the amount of the material available to the editors and their staff of critics was clearly not sufficient to allow the picture presented to be in any way adequate to the facts. But for all the earlier portions, and for the literary and artistic criticism of classical works of all kinds, published quite recently, the catalogue is a gold-mine. One finds here an account of books often not otherwise known at all in England, and the short summary and criticism appended are always expert, sufficient and enlightening. One short and interesting example (of the hundreds which the book contains) may be given:

"Nogara Bartolomeo. The Laocoon group in the Vatican.

"A summary history of the group since its discovery. Different attempts at restoration are described. . . . Interesting proof arises from Titian's travesty in his 'Apes-Laocoon', that the chief figure had his arm bent towards his head."

In recommending the whole undertaking, one would only repeat the hope that in the development of the work of the Warburg Institute in London, larger and larger attention may be given to the history of science. On art it is already ample and admirable. F. S. MARVIN.

Mechanisation in Industry

Mechanisation in Industry

By Harry Jerome. (Publications of the National Bureau of Economic Research, Inc., No. 27.) Pp. xxxi+484. (New York: National Bureau of Economic Research, Inc., 1935.) 15*s*. net.

THE habit of producing goods whether they are needed or not, of applying power whether it is effective or not, of utilising inventions whether they are useful or not, pervades almost every department of our present civilisation. The untoward consequences of this materialistic habit, as seen for example in employment, have led to increasing attention being given to the social consequences of mechanisation in recent years. We are at last coming to realise that social inefficiency may be too high a price to pay for mechanical efficiency and that, from the point of view of the community as a whole, industrial efficiency must take account of the effects on the worker and the community as well as of the purely mechanical or chemical efficiency of its processes.

Although the social and cultural aspects of mechanisation have received a certain amount of attention, there has as yet been no detailed account of the process of mechanisation in a broad economic setting, interpreting the details in regard to mechanisation as a whole and to related processes of economic life. Some such account Dr. Jerome attempts to give us in the present study, particularly in relation to the nature and significance of current changes in the degree of mechanisation. He emphasises the wide range of consequences which must be traced if we are to measure accurately the effects of a mechanical change, and his careful technique of treatment should supply a further corrective to hasty or ill-founded assumptions regarding the effects of mechanisation.

In the first instance, Dr. Jerome distinguishes between changes which increase the units of output per hour of labour and those which reduce the number of workers required. He also directs attention to the effects which may be produced not merely on labour operating a process but also on auxiliary labour such as that required in maintenance, or on embodied labour such as that required in the production of the machine or the power or other services required for its operation, as well as on indirectly required labour like that engaged in transport, selling or advertising. It is only as the effects in all these directions are visualised that we can compute the true effect of a technical change on the community, and attain such an understanding of current changes that the manner and rapidity with which they occur can be in some degree controlled.

Dr. Jerome suggests that the most important single question about current changes in mechanisation is the rate at which they occur. The evidence presented, drawn from a wide range of manufacturing industries as well as from agriculture, mining, building, transport and handling of

materials, etc., leads him to conclude that a continuing increase in mechanisation at a moderate pace may be expected. Though there are still many possibilities for the extension of mechanisation, there are sufficient obstacles to mechanisation to render uncontrollably rapid mechanisation unlikely. On the contrary, stabilising factors which limit the rate of mechanisation also suggest that the rate of change in mechanisation is relatively stable. Even within the limited range of fluctuations in the rate of mechanisation, the experience of the last ten or fifteen years indicates ill effects which deserve consideration and, moreover, are not beyond reasonable possibility of prediction and control. For example, rapid mechanisation brings a substantial amount of displacement of skill and technological unemployment which, even when the change represents a net gain to society as a whole, may bring serious losses to individual workers, particularly to the older and more highly skilled. Moreover, there is reason to believe that, while advancing mechanisation probably tends to lessen seasonal fluctuations in industry, it may aggravate cyclical fluctuations.

The evidence upon which these conclusions are based is admirably presented, and is supported by statistical data which give the book real value as a work of reference upon the rate of mechanisation of industry. The book is eminently readable, and, while limiting himself closely to the special aspects of mechanisation indicated above, Dr. Jerome indicates a number of directions in which further investigation is required. The challenge to research thus thrown down by problems of obsolescence and plant occupation, the effects of mechanisation upon labour turnover, etc., is not the least of the claims of this book upon the attention of the scientific worker. R. BRIGHTMAN.

Witchcraft and Psychopathology

The Medical Man and the Witch during the Renaissance

By Dr. Gregory Zilboorg. (The Hideyo Noguchi Lectures.) (Publications of the Institute of the History of Medicine, the Johns Hopkins University, Third Series, Vol. 2.) Pp. x+215+5 plates. (Baltimore, Md.: The Johns Hopkins Press; London: Oxford University Press, 1935.) 11*s*. 6*d*. net.

WITCHCRAFT and the witchcraft persecutions were a manifestation of the hysteria endemic among the European populations of the Middle Ages; and after the Renaissance, even when the flame of seventeenth century fanaticism, which made a belief in witchcraft a test of orthodoxy, had died down, sporadic outbursts of popular excitement still showed that the evil had not been completely allayed.

In these three lectures Dr. Zilboorg, skilled psychiatrist and trained sociologist, examines the records of the fifteenth and sixteenth centuries with the purpose of demonstrating why, while other branches of medical sciences at the time of the Renaissance entered upon a period of rapid growth with the introduction of the scientific spirit and scientific method, the true nature of the phenomena of witchcraft and demonic possession was only tardily recognised as due to an abnormal psychic state—and that merely by the few. The study of psychopathology and psychiatry made no advance between the middle of the sixteenth century and the end of the nineteenth century.

In the "Malleus Maleficarum", the guide to theory and practice of the medieval inquisitor and witch-finder, there is, Dr. Zilboorg shows, a complete clinical record of psychic abnormalities known to modern science. He also shows by an analysis of records of the examination of cases of demonic possession and of the writings of such authorities as Paré, Paracelsus and Cornelius Agrippa, that medical men 'shied away' from a province expressly, and often explicitly, debarred from the healing art and consigned to the Church and the Law, either as heretical and criminal—the witch; or as spiritual—the demonically possessed.

Glimmerings of the truth are to be observed among the more advanced masters of medicine, as, for example, in the writings of Paracelsus and Agrippa; but as Dr. Zilboorg shows by copious quotation, the introduction of a scientific attitude of mind and of accurate clinical observation of cases in this field is due to Johann Weyer (1515 or 1516–88), native of Brabant and physician to Wilhelm, Grand Duke of Trier. Weyer was the founder of psychiatry. Unfortunately, Weyer's work became inextricably entangled in the conflicts between heresy and orthodoxy and the Roman and the reformed Churches. Hence, notwithstanding the decay of the active belief in witchcraft, the field of psychopathology continued to be dominated by the theological attitude towards possession for just on three hundred years.

Study of X-Rays

X-Rays in Theory and Experiment

By Prof. Arthur H. Compton and Prof. Samuel K. Allison. Second edition of "X-Rays and Electrons" by Arthur H. Compton. Pp. xiv+828. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1935.) 31*s*. 6*d*. net.

"X-RAYS in Theory and Experiment" was originally conceived as a second edition of Compton's deservedly celebrated "X-Rays and Electrons". That book was published just at the time when the great revolution in physical theory, characterised by the new quantum mechanics, was making itself felt, and the changes which this new outlook produced—changes due not in small part to the work of the authors—have caused instead a second book to be written, twice as large, and containing far more than twice the amount of data and interpretation.

It is, of course, a different kind of book from "X-Rays and Electrons". The first was the product of pioneering and provocative research. The Compton effect was one of those final discoveries that made reconciliation between the wave and quantum aspects of radiation seem altogether impossible, and the impossibility of this reconciliation was underlined and emphasised all through the book. The theoretical physicists could no longer evade the contradiction; they must resolve it; and thus, through the works of de Broglie, Schrödinger, Heisenberg and Dirac we have learnt that both the wave and the quantum form are valid not only for radiation, but also for matter, and in a way that obliges us to consider both as we had never thought of them before. The contradictions earlier raised by Compton now found their solution in wave mechanics in the uncertainty principle, and so the new book takes on a far more finished character than the old. Problems and difficulties still remain, but they are no longer the predominating note. Instead, we have presented in field after field a satisfactory quantum mechanical explanation of the phenomena.

The subject covered by the book is one of those divisions of physics which, growing up naturally, takes its part in the classification of physics based essentially on the size of the energy changes with which it deals. Normal optics is concerned with changes from a fraction of a volt to 100 electron volts, X-rays in the widest sense from 100 to 100,000 volts, but mostly in the tens of thousands, and beyond it, there are nuclear physics and the ultra-physics of cosmic rays, ranging into millions and thousands of millions of volts. From another point of view, the study of X-rays is an extension of the familiar theories of physical optics in an unfamiliar world, where the apparatus is no longer mirrors and lenses, but crystals and electron clouds, and the refractive index is both imaginary and less than one. We have a theory of spectra, of fluorescence, of absorption and dispersion, just as in the optical field, as well as a theory of scattering and diffraction. On the experimental side, things are, of course, very different; all beams are divergent beams limited by slits. The one link is the photographic plate, but apart from that the ionisation chamber and the Wilson chamber take the part of the human eye, while the single and the double crystal spectrograph replace the spectrometer and the interferometer in the analysis of wave-lengths.

One of the particular advantages of the book is the logicality of its arrangement. After the history of X-rays, the theory of their production is discussed, and then of their scattering—by electrons, by atoms, by liquids and by crystals. In the light of this knowledge, particularly of crystal refraction, the fluorescence, the absorption and the spectroscopy of X-rays are treated. One of the most interesting chapters is Chapter iii, dealing with the theory of scattering and incorporating a great deal of Prof. Compton's new work. It is in itself an admirable introduction to the new quantum theory. In the first section, the experimental evidence for light consisting of discrete quanta is derived both from the change of wave-length on scattering and its dependence on angle, and from the velocity and angular distribution of the recoil electrons.

The next section gives the resolution of this dilemma by means of wave mechanics, where we are dealing with the interference of two trains of waves, photonic and electronic. It is possible to go further, and obtain, from the fine structure of the Compton scattered line, the analysis of the distribution of electronic velocity in an atom, complementary to the distribution of electronic density which is derived from the unmodified scattering. The next chapters of the book give a comprehensive account from the physicist's point of view of the scattering of electrons by gases, liquids and crystals.

It should be emphasised that the book is primarily a physical treatise concerned with the principles of the relation of X-rays, electrons and matter, and not with the chemical or crystallo-

graphic question of the structure of the different forms of matter. The accounts of the methods of X-ray crystal analysis would not, and cannot be expected to, be of the nature of a manual of practical crystal analysis, but it will be a great help for chemists and physical chemists if physicists acquire in this way a knowledge of the principal developments in this field. It would be possible, for example, to criticise as inadequate the information offered as to detailed electronic configuration of certain atoms, where values are quoted coming from work which has been superseded. In the same way, in the question of the structure of liquids, not enough account has been taken of the work of Prins, while other results, which are strictly applicable only to a certain class of polar liquids, have been given a too general application.

Particularly useful are the chapters on dispersion and absorption of X-rays—questions which have rarely received such comprehensive treatment in English works. The value of the section on X-ray spectroscopy lies particularly in the space given to the detailed analysis of spectral lines by means of the double crystal spectrometer which has been the particular work of Prof. Allison, and until now has been far too little known. A critical discussion of the value of the electronic charge, whether based on oil-drop or absolute wave-length measurement—which give a difference between 4·77 and $4{\cdot}80 \times 10^{-10}$ E.S.U.—is not brought to any definite conclusion: in fact, as yet, this crucial metrical problem has not been solved.

The presentation of the book is excellent. In the figures a new method of rather violent perspective and shading is used to give three-dimensional impression in an effective, though somewhat startling, way. Both in the book and the appendixes there are contained the tables of the latest values of most of the fundamental atomic constants, structure factors, wave-lengths, absorption coefficients, etc. "X-Rays in Theory and Experiment" cannot fail to become a standard work of reference, both for physicists and crystallographers.

J. D. BERNAL.

Experimental Bacteriology

Experimental Bacteriology in its Applications to the Diagnosis, Epidemiology and Immunology of Infectious Diseases

By Prof. Dr. W. Kolle and Prof. Dr. H. Hetsch. Translated from the seventh, completely revised German edition by Dagny Erikson. The English version, incorporating further revision, edited by Prof. John Eyre. Vol. 1. Pp. 592+49 plates. Vol. 2. Pp. 613+62 plates. (London: George Allen and Unwin, Ltd., 1934.) 30*s*. net each.

THE classical German textbook, which enjoyed much popularity under the title "Experimentelle Bakteriologie", has been translated into several languages and now appears for the first time in English. The whole work comprises two large volumes each of more than five hundred pages, and has been edited by Prof. Eyre. It may be stated at once that this has been well done, and that all those interested in bacteriology in its relation to disease, whether from the point of view of student, teacher or investigator, will be grateful to have this German work more easily accessible by reason of its English version.

The first volume follows the conventional course by opening with chapters on general morphology and the biological aspects of pathogenic organisms and on immunity. Serological diagnostic methods appear in due course, and the ground is prepared for the ensuing descriptions of purely bacterial infections such as diphtheria, anthrax, typhoid fever, the streptococcal infections, the anærobes, etc. With the exception of tuberculosis and leprosy, infections of bacterial origin are included in this volume.

The second volume deals with infections with the acid-fast bacteria, spirochætal infections, tropical diseases, the filterable viruses affecting man, and to some extent animals, and the filamentous fungi and yeasts.

Though this subject is vast, there is no suggestion that there has been undue compression of material. Each chapter deals with its subject matter in a quite convincing and, for the most part, thorough way. Each disease is treated from the aspects of causative agent, diagnosis, epidemiology and immunology and, where possible, information gathered from post-mortem material is included. It would, indeed, be difficult to better many of the descriptions, which are liberally reinforced by excellent illustrations, many of them colour plates, which are a very valuable addition to the work. These volumes will make an appeal because the difficult liaison between clinical and laboratory knowledge has been brought about in a natural and convincing way without undue stress on either branch. It is at the same time a work for the student of medicine, for those whose interest lies primarily in tropical medicine and a useful book of reference for the investigator.

The work as a whole is not, however, free from faults, some of which are glaring and could easily have been avoided. It is not surprising to find confusion in such terms as "typhus" and "typhoid" and it would be, perhaps, wiser in an English edition to avoid the use of the term "spotted fever". The word "virus" also connotes nowadays a recognised group of infective agents rather than a general term, and should not be used in connexion with such diseases as syphilis. These faults are not really important. Much more serious, however, is the inescapable conviction that reference to foreign published work, particularly English and American, is to a very great extent absent. It may be that the authors had not ready access to these publications, although it is difficult to believe that the absence of the Kahn test from the discussion on the serological diagnosis of syphilis can be put down to this. It should, beyond question, have found a place alongside the Meinicke and Sachs-Georgi methods. There is also a tendency to refer to the work of investigators throughout the text while omitting it from the list of references. The value of these volumes as a work of reference has to some extent suffered by such omissions.

As a general rule, whilst the authors are progressing along the older and better beaten paths of bacteriology, there is a surety of treatment and a careful discrimination in the selection of available material. The case of the filterable viruses, however, is not so happy. There it is essential to move with the times, and this has not been done. Certain filterable viruses, such as louping ill and Rift Valley fever, have been missed completely. Admittedly, to be quite up to date in a large published work is difficult, so rapid is the progress in this highly important field. In dealing with the question of psittacosis, reference to work so recent as 1934 is found, and a quite useful account of the disease is given. It is a mistake to dismiss the problem of prophylactic measures in the control of yellow fever without mention of the promising results of vaccination. The cultivation of filterable viruses is now an accomplished fact, and several investigators have made convincing claims for its practical importance in smallpox vaccination.

A true indication of the nature of the filterable viruses has not been given in these volumes by reason of omission of more recent work along this line. On this point, reference is made to the experiments of Frosch and Dahmen with foot-and-mouth disease, whereas no mention is made of the very important work of the Maitlands and of Hecke. Nor is it a good reflection of generally accepted opinion to find on page 523 of vol. 2 the statement that the Borrel bodies in fowl-pox are "specific products of reaction of the tissues". These are but a few instances, and no doubt in future editions the treatment of the filterable viruses will follow more closely recent developments and so reach the same high standard which for the most part characterises the rest of the work.

The translation, which must have been an arduous task, has been admirably done.

Les plantes alimentaires chez tous les peuples et à travers les âges:
Histoire, utilisation, culture. Par Prof. D. Bois. Vol. 3: Plantes à épices, à aromates, à condiments. (Encyclopédie biologique, Vol. 7.) Pp. iii+289. (Paris: Paul Lechevalier, 1934.) 50 francs.

THIS part of the "Encyclopédie biologique" deals primarily with spices but contains, in addition, useful information on a number of economic plants yielding edible products that may not be generally regarded as spices.

The first half of the volume deals with the true spices, and the early pages are devoted to an interesting historical account of the spice trade, the early days of which were so filled with romance. The more important spices such as pepper, nutmeg, cloves, cinnamon, ginger, chillies and vanilla are dealt with in detail, while those of more limited consumption such as turmeric, Guinea grains and star-anise receive more summary treatment. In addition to a description of the spice and the plant yielding it, information is given regarding areas of production, cultural requirements and practice, yields, uses and common names in various languages.

In the section devoted to condiments there are good accounts of mustard, horse-radish and the various representatives of the families Umbelliferæ, Compositæ and Labiatæ that fall under this category. Brief accounts of edible oil- and sugar-yielding plants are given at the end of the volume. Their inclusion in a volume devoted to spices and condiments is perhaps somewhat surprising.

Structure et propriétés des noyaux atomiques:
Rapports et discussions du Septième Conseil de Physique tenu à Bruxelles du 22 au 29 Octobre 1933 sous les auspices de l'Institut International de Physique Solvay. Pp. xxv+365. (Paris: Gauthier-Villars, 1934.) 75 francs.

THE report on the seventh Solvay Conference (1933) at Brussels contains papers by Cockcroft, Chadwick, the Joliots, Dirac, Gamow, Heisenberg, with discussions by a galaxy of notable physicists on the structure of atomic nuclei, neutron, positron, neutrino and the 'materialisation' of gamma rays. The report adopts and recommends the notation $^{4}_{2}He$, $^{226}_{88}Ra$, and so forth, rather than $^{4}He_{2}$, $^{226}Ra_{88}$ . . . , a change which the chemist would approve. In these days of rapid development of atomic physics, it would be a great boon to receive these reports within a few weeks of each conference, and to find them with their edges cut.

Quelques éclaircissements épars sur mes Monumenta Cartographica Africae et Aegypti
Par Prince Youssouf Kamal. Pp. vi+216. (Leiden: E. J. Brill, S.-A., 1935.)

STUDENTS of the history of cartography in general, and of African cartography in particular, are deeply indebted to Prince Youssouf Kamal for the inception and production of his lavishly designed volumes—"Monumenta Cartographica Africae et Aegypti"—which he is presenting to all the important libraries of the world. When completed, this work will prove a valuable storehouse of cartographical material for students, to whom much of it would otherwise be inaccessible. Interpreting his title widely, he includes not only reproductions of original maps, but also reconstructions of the historical geography of various periods, and extracts from contemporary writers containing topographical references. The present volume is largely an explanation of the scheme upon which the "Monumenta" have been designed, and a commentary upon the material already published.

It is not a comprehensive history of cartography; the author is content rather to discuss, without being didactic, and sometimes discursively, some of the major problems, and to indicate lines of profitable research. Such points are the symbolical character of early maps, the origin of the maps illustrating Ptolemy's Geography—he omits consideration of the probability that the tables of data were largely derived from maps of some kind—the content of medieval *TO* maps, and the work of the Oriental or Arab cartographers. His analysis of the latter reinforces the evidence for their dependence upon classical sources. In discussing his plan for the final volume dealing with the European discoverers of the early modern age, he presents a useful summary of the cartographic evidence for maritime activity along the coasts of north-west Africa prior to the movement associated with the name of Prince Henry. It yet remains to be demonstrated by whom this work was performed, and the relative contributions of Portuguese, Spanish and Italian pioneers. It is evident that this formidable undertaking is the work of a true enthusiast, and a patron of research.

G. R. C.

Fundamentals in Teaching Home Economics
By Ivol Spafford. Pp. xiii+424. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 13*s*. 6*d*. net.

FEW students of social problems to-day will question the general statement that the strength and sanctity of home life is still one of the most vital elements in the national fabric; and that the efforts now being made by far-sighted educationists to place the study of home economics on a firm basis, occupying a high and secure position in school curricula, merit every encouragement. This need was well recognised by the inclusion in the recent Congress for Scientific Management of a section for domestic economy; and in the present excellent and comprehensive work that need is still more clearly and fundamentally emphasised and provided for. The book deals of course with the teaching of home economics in the United States, but its breadth of view and depth of thought are such as to make it international in scope and application.

Home economics is here seen to be a matter of deep interest to everybody, to all indeed who have or hope to have any sort of home life and wish to make the best of it in all its varied intellectual, practical and emotional aspects. It is something vastly greater than a cookery or sewing class for adolescent girls. It makes a stirring appeal to boys and to adults of both sexes. It reaches down to the fundamentals of education in its analysis of the desire to learn, to know the truth, of thinking and self-directed education, of measuring progress in learning, and of the philosophy of education in general. But besides these deeper general aspects of the subject, the book contains a wealth of practical and helpful instruction to the teacher in a very difficult field, based on the author's own wide experience and profound study which, judging from the copious list of references appended to each chapter, must have been of an unusually complete and indefatigable nature.

Sumatra
Its History and People, by Edwin M. Loeb; The Archaeology and Art of Sumatra, by Robert Heine-Geldern. (Vol. 3 of Wiener Beitrage zur Kulturgeschichte und Linguistik des Institutes fur Volkerkunde der Universitat Wien.) Pp. ix+350+40 plates. (Wien: Verlag des Institutes für Volkerkunde der Universität, 1935.) 23 Österr. schillings; 4.40 dollars.

ALTHOUGH both the authors of this volume have a first-hand knowledge of the indigenous peoples of the Dutch East Indies, they do not claim to have attempted more than compilation. The result of their labour is, nevertheless, welcome to English readers, among whom a knowledge of the Dutch language, in which the copious literature dealing with the antiquities, culture and peoples of these islands for the most part has appeared, is either non-existent or far from profound. A reference to the extensive bibliography of the works upon which they have drawn for their material will show how very extensive this literature has come to be. To a great extent, the bar of language has been responsible for the fact that the position of the Javanese in the ethnology of Indonesia and as a link extending from New Guinea to the Malay Peninsula has received less consideration than its importance warrants.

In the section dealing with art and archæology, the author distinguishes no less than ten cultural strata extending in date from palæolithic (here a cultural rather than a chronological term in the strict sense) to the Chinese influence of the end of the fourteenth century A.D. It is to be noted that in the palæolithic he discriminates between a flake culture, which he holds to be probably Veddoid, and a hand-axe culture, which he would assign to the Papuo-Melanesian.

The book is illustrated by excellent photographs.

Diesel Engines and Coastal Shipping

DURING the meeting of the British Association at Norwich, an evening discourse was delivered on September 6 by Dr. S. J. Davies on Diesel engines and coastal shipping.

After referring to the remarks of Sir Frederick Bramwell in 1881 and the comments made by Sir Alfred Ewing in 1931 on Bramwell's suggestion that by 1931 steam engines would be superseded by internal combustion engines, Dr. Davies said that, for transport by road and in the air, the internal combustion engine holds a practical monopoly, but in large power stations the steam installation successfully meets competition. But the contest goes on, improvements in competing types appearing almost daily, while apparently unimportant developments in physics or metallurgy may have far-reaching consequences. The production of a better heat-resisting metal, for example, might change the whole position of the contest. The competition in the marine-engine field has proved one of the most interesting. On passenger liners the contest between the two divisions of steam engines, reciprocating and turbine, had first to be settled. To-day, while the steam turbine shows outstanding advantages for the largest passenger liners, Diesel engines have met with some success on the smaller liners, although the question is still very open. It is in the remaining classes of ocean-going vessels of the mercantile marine that Diesel engines have their greatest application, while in the last few years their importance in coastal work has steadily increased.

The term 'coastal shipping' includes a variety of craft, but for his purpose Dr. Davies confined himself to the three divisions: tugs, fishing vessels and coasters. In comparison with ocean-going vessels, these are limited in size and in the lengths of their voyages. These limitations involved factors quite different from those governing the design of ocean-going ships and their machinery. Ocean-going vessels spend by far the greater proportion of their time under way in travelling steadily at normal engine speeds, the proportion of time at reduced speeds and while manœuvring in harbour being small. In other words, the loads on the engines are for the most part uniform, and the demands made in respect of repairs and overhauls consequently less exacting than in coastal vessels. An ocean-going ship might go for days without the engineers receiving any orders from the bridge, and all running conditions—such as cooling water temperature, injection, adjustments, etc.—can be set and left unchanged.

The coasting vessel, on the other hand, is steaming to bell most of the time; entering ports and rivers, docking, turning and then steaming on to its next destination through relatively crowded waterways. It is thus essential that the engines of the coaster should continue to work without detail supervision, and that they should withstand without difficulty both the mechanical stresses imposed by rapid changes of load and speed, and also the changes of engine temperature involved. In coasting vessels, the opportunities for carrying out repairs and adjustments are more limited. Then, too, limitation of size involves other conditions. Whereas the ten-thousand ton vessel has a little spray blown over the engine-room hatchway in bad weather, a moderate breeze will cause a small coaster to be drenched with spray, and so the engine must be made waterproof. The coaster too, lying alongside quays, is exposed to dust and grit, and the machinery should be totally enclosed to avoid the wear of working parts from the abrasive action of the grit. It is therefore clear that the machinery works under most exacting conditions, and it is necessary that everything possible should be done to lighten the duties of the engineer and to facilitate the repair or renewal of engine parts.

The Diesel engine for coasters is still in the experimental stage. Many firms are entering the field, and the Diesel engine is justifying itself handsomely in certain applications. Nevertheless, the full benefits of the Diesel engine cannot be realised until a limited number of designs can be standardised. As a result of such standardisation, the first costs of the engines should be lower than at present, spare parts should be readily and cheaply supplied, and the proportion of time the vessel is laid up for overhauls should be reduced. One direction in which the duties of the engineer could be lightened is by removing the navigational control of the machinery from the engine-room to the bridge. The handle of what is normally the engine-room telegraph should be the control handle on the bridge, and the change of speed and reversing the propeller should be fully automatic in response to the movement of this handle.

Investigations into the wear of Diesel engine cylinder liners have demonstrated the bad effect of changes of temperature of the circulating water and in particular of running an engine with cold circulating water. Coastal vessels, with their rapid changes of load and speed, and relatively frequent stops, are especially subject to

these unfavourable conditions, and it would be sound economy on all but the smallest vessels to take steps to reduce their effects. To ensure efficient cooling of the cylinders, cooling, in all but the smallest vessels, should be by fresh water passing round a closed circuit consisting of a small tank well above the engine, feeding into the line near the pump suction, and a tubular cooler placed well down in the ship. Clean lubricating oil is always an economy. This is provided by employing the 'dry sump system' in which the oil from the crank chamber is forced into a storage tank through filters which extract the solid particles. The filtered oil is drawn from the storage tank, and delivered under pressure to the engines.

While matters of design, control and upkeep are common to all classes of vessels, each kind of service brings its own special problems, and the examples quoted should show how these have been solved. Diesel engines for tugs have become of considerable importance in the last seven years. On the Thames, goods are carried in flat-bottomed barges which are towed downwards and upwards with the tide, the current at full ebb and flow being about 3 knots. There are approximately 350 tugs engaged in lighterage on the river, of which already 150 are motor tugs. The Thames Steam Tug and Lighterage Co. has been one of the pioneers in the use of Diesel engines, and one of their vessels has been in use for more than five years. In the *Irande*, the propelling machinery consists of a six-cylinder directly-reversible four-stroke Carels-Ingersoll-Rand engine developing 340 b.h.p. Another vessel of the same company, the *Framfield*, has two six-cylinder four-stroke engines, each driving a dynamo delivering current at 350 volts to a 400 s.h.p. propulsion motor. Control is from the bridge, there being two control handles, one on the port side and the other on the starboard side, so that the steersman can use the one most convenient to him. Mr. F. T. Mayor, the superintending engineer of the company, kindly supplied figures which made a comparison of the working costs of a steam tug and motor tug possible. These figures are very favourable to the motor tug.

As regard fishing vessels, the application of Diesel engines has been very uneven at the various ports. The Cornish fishermen, for example, have applied small engines to practically all their sailing vessels. The Scottish fishermen have gone further and have applied Diesel engines to many vessels of the sizes formerly steam-driven. The larger classes of trawlers, having displacements up to 2,300 tons, have engines of 1,000 h.p. and more. Several such vessels have been built in Great Britain, but mainly for French owners, and are employed in cod-fishing. There is a difference of opinion as to the question of drive in certain classes of fishing vessels. For the largest vessels, directly-reversing engines with direct drive to the propeller are usual; for small vessels, combined speed-reduction and reversing gears give the best service. In view of the large mass of experience already gained at home and abroad with Diesel-engined vessels, reliability in service may now be taken for granted. Other factors must, of course, be taken into account in making a comparison between steam engines and Diesel engines, and since the first costs of the latter are higher than those of the former, Diesel engines must show other advantages to counterbalance their higher capital charges. These compensating advantages follow mainly from two important facts: first, for the same power and output Diesel engines occupy considerably less space than the corresponding steam engines and boilers; secondly, the Diesel engine has a much higher thermal efficiency than the steam engine.

Turning to the third division of coastal vessels, the coasters, Dr. Davies said the primary duty of these is to convey goods, although small numbers of passengers are carried in some of the larger vessels. Among the companies who have recently adopted Diesel engines for coastal work is Messrs. Coast Lines, Ltd. The first of their four motor-ships was launched just two years ago and the fourth in July last. Their M.V. *Pacific Coast* has a dead-weight capacity of 1,755 tons. She is a twin-screw vessel, having two five-cylinder Polar-Diesel two-stroke engines, each developing 628 b.h.p. at 250 r.p.m. The auxiliaries are all electrically driven, current being generated by three oil-driven dynamos.

Such large vessels, however, are exceptional and, in view of the smaller difference between their work and that of ocean-going vessels, the superiority of Diesel engines in their case could be almost taken for granted. In tugs and fishing vessels, too, the matter seems also to be clearly proved. It may be summarised broadly by saying that where the vessel is for the greater part of its time under way, the advantages of the Diesel engine more than balance its higher first cost.

Whether as a result of the application of the Diesel engine or not, there is an undoubted revival of interest in coastal shipping. That this question is being approached more scientifically than hitherto is to be seen in the recent report of the work of the Froude Tank at the National Physical Laboratory. It is interesting to note, too, that the researches carried out have led to results definitely favourable to engines driving propellers at higher speeds of revolution, which is usually the case when Diesel engines are employed. Dr. Davies' lecture throughout was illustrated with slides of the various types of craft and their machinery.

Absolute Units and Electrical Measurements

By Sir Richard Glazebrook, K.C.B., F.R.S.

THE absolute system of electromagnetic units was developed by the British Association Committee on "Practical Standards for Electrical Measurements". Of this Committee Sir Wm. Thomson (Lord Kelvin) and Clerk Maxwell were the leading members and the development of the system is mainly due to them. It may be of interest to have here a brief account of what is meant by an 'absolute system'.

The meaning given to the term 'Absolute Measurement' was clearly explained by the B.A. Committee in the report to the Newcastle meeting in 1863. The Committee states :—

"The word 'absolute' in the present sense is used as opposed to the word 'relative' and by no means implies that the measurement is accurately made or that the unit employed is of perfect construction, but only that the measurement, instead of being a simple comparison with an arbitrary quantity of the same kind as that measured, is made by reference to certain fundamental units of another kind treated as postulates."

"For true absolute measurement the unit of force is defined as the force capable of producing the unit of velocity in the unit of mass when it has acted on it for the unit of time. Hence this force acting through the unit of space performs the absolute unit of work. In these two definitions, time, mass, and space are alone involved and the units in which these are measured, i.e., the second, gramme and metre* will alone in what follows be considered as fundamental units."

The Report then goes on to consider the mechanical, chemical and thermal effects due to electrical action, and since the chemical and thermal effects are measured by reference to a mechanical unit of work, concludes that it is only necessary in developing an absolute system of measurement to attend to the connexion between electrical magnitudes and the mechanical units. We are thus led to the following explanation of an absolute system of measurement.

Electric or magnetic systems exert force and are sources of energy. Force and energy are measured in terms of length, mass and time.

The forces between two quantities of electricity or two magnetic poles, measured in any units whatever, can be shown to be proportional to the product of the charges or of the poles and inversely to the squares of the distance between them. The constants of this proportion form the links required to connect quantities of electricity or of magnetism with the fundamental units. A third constant is required to determine the relation between a quantity of magnetism and an electric current. These three constants, usually denoted by K_0, μ_0 and A, are reduced to two because it can be shown that

$$A^2/\mu_0 K_0 = C^2,$$

where C is the velocity of wave propagation.

In order to form an absolute system of electrical measurement, it is absolutely necessary to know *two* of these constants, which thus form the links connecting electrical and magnetic quantities with the fundamental units of length, mass and time. Such is the basis of the system of measurement conceived by Maxwell and the B.A. Committee in the year 1863.

The committee selected as fundamental units the centimetre, the gram and the second, thus establishing the C.G.S. system. That, of course, was not necessary; the metre, the kilogram and the second might have been taken, but the choice was deliberate and only arrived at after much inquiry*.

To complete the electromagnetic system the Committee had to select the values of the two constants μ_0 and A. It was at liberty to select any values it pleased for these; the selection would determine the units in terms of which quantities of magnetism and currents of electricity were to be measured. Further investigation showed that μ_0/A represents permeability—the ratio of the magnetic induction at a point in space to the magnetising force at that point—and it was a very natural step to assume that this ratio was unity, that is, to select the permeability of space as the unit of permeability, and thus to make $\mu_0/A = 1$ on the C.G.S. system of absolute units.

A further assumption was required as to A, and for this the Committee selected the value unity. It thus formed the C.G.S. absolute system of electrical measurement with the centimetre, gram and second as basis, together with unity as the value of each of the necessary constants μ_0 and A.

* The metre was changed later to the centimetre.

* See B.A. Reports on Electrical Measurements. A Record of the History of "Absolute Units" and of Lord Kelvin's work in connection with these. Reprinted by the Association, 1912 (Cambridge University Press). See also "Dictionary of Applied Physics", vol. 2, page 941, article on units of electrical measurement.

The last assumption, that A is unity, implies that $\mu_0 K_0 C^2$ is unity, and hence that $K_0 = 1/\mu_0 C^2$.

For mechanical purposes the M.K.S. system is excellent and has many advantages, the main one perhaps being that the Joule, 10^7 C.G.S. units of energy, is on that system unity. But in my view the M.K.S. (Resistance) system is not an absolute system of electrical measurement. A material substance—a tube of mercury or a coil of wire—will not of itself serve to connect electrical quantities with length, mass and time. There is a sense perhaps in which the M.K.S.Ω system (Ω the ohm) may be looked on as a kind of hybrid absolute system because the ohm, 10^9 absolute C.G.S. units of resistance as defined by the B.A. Committee, is by that system linked to the units of length, mass and time. Personally I should greatly regret to see the word 'absolute' divorced from its original meaning.

The M.K.S. system can, of course, become 'absolute' for electrical measurements just as the C.G.S. system has done. Three constants will be required: we may call them K_1, μ_1 and A_1. They will be connected by the equation

$$A_1^2/\mu_1 K_1 = C_1^2,$$

where C_1 is measured in metres per second.

On the C.G.S. system, A is an undimensional constant arbitrarily assumed equal to unity; we may agree to make the similar assumption on the M.K.S. system and thus put A_1 = unity. We are also free to assume any value we like for μ_1 which leads to the result that $K_1 = (\mu_1 C_1^2)^{-1}$, and we have then a second quite satisfactory system of 'absolute measurement'. This will usually differ from the C.G.S. system. If, however, we choose for μ_1 the value 10^{-7}, the M.K.S. system leads to practical results identical with those of the C.G.S. system, and the accompanying table gives the relations between the various quantities involved—it might, of course, be extended to include others.

M.K.S. system, may be selected as a fourth fundamental quantity required by the M.K.S. system. It must, of course, be remembered that a fifth such quantity is needed and completeness is attained by assuming for the value of A_1 unity, as the B.A. Committee did for A.

At a conference at which I was present recently the question was asked: "What is the need for a 'fourth unit'?" The reply was to the effect that the 'fourth unit' is needed to complete the dimensional equations. Thus it is not put forward to simplify electromagnetic theory or place it on a firmer basis, but to fill a supposed gap in the dimensional equations.

Dimensions, as the term is used by Maxwell, have reference to the three fundamental quantities of length, mass and time, and he set out with the object of expressing all electrical quantities in terms of these three. This proved to be impossible. Using more modern terms and symbols, the quantities denoted now by A, μ_0 and K_0 are involved and these are connected as explained above by the equation $A^2/\mu_0 K_0 = C^2$.

The dimensions of $\mu_0 K_0/A^2$ are those of the reciprocal of the square of a velocity, but without some further assumptions we can proceed no further. Maxwell tacitly assumed A to be unity and undimensional, leading to the result that $\mu_0 K_0 = 1/C^2$.

Maxwell points out that two assumptions are possible: on the one, the electromagnetic, μ_0 is treated as an undimensional constant of value unity and we have the electromagnetic system, on which, for example, the dimensions of a resistance are those of a velocity, those of a coefficient of induction are a length, etc. For the electrostatic system, K_0 is treated as an undimensional constant of value unity.

There is, however, another solution to the equation $\mu_0 K_0 = 1/C^2$. We may assume μ_0 and K_0 each to have unknown dimensions in length, mass and time, but to be so connected that the dimensions of their product are those of $1/C^2$. The dimensions of a coefficient of induction are then those of $\mu_0 \times L$; those of a resistance are those of

TABLE SHOWING THE RELATION BETWEEN QUANTITIES ON THE C.G.S. ELECTROMAGNETIC SYSTEM AND ON THE PROPOSED M.K.S. SYSTEM

	Length	Mass	Time	Space Permeability μ_0/A	Electromagnetic Coefficient A	Coulomb	Ampere	Volt	Ohm
C.G.S.	1 cm.	1 gramme	1 second	1	1	10^{-1}	10^{-1}	10^8	10^9
M.K.S.	1 metre	1 kilogramme	1 second	10^{-7}	1	1	1	1	1

On Maxwell's theory of the electrical field the permeability of space is assumed to be a quantity having dimensions. The value, therefore, will depend on the system of units employed. The symbol μ_0 is used to denote this quantity. On the C.G.S. system the permeability of space has been selected as the unit of permeability. Hence on this system the value of μ_0 is unity. On the M.K.S. system its value is 10^{-7}, and on the 'rationalized' M.K.S. system the value of μ_0 is $4\pi \times 10^{-7}$.

At the same time the S.U.N. Commission desires to take this opportunity of placing on record its recognition of the fact that there are important electrical theories supported by a number of physicists in accordance with which $\mu_0 K$ is a pure number.

This, then, briefly gives my reason for the desire that 10^{-7}, the value of space permeability* on the

* In cases in which it is desired to use the "rationalized system of units", this will become $4\pi \times 10^{-7}$, while the value of A will be unity.

$\mu_0 L/T$, and both are unknown. But nothing is really gained by taking either of these quantities as a 'fourth unit' and treating it either as a fourth dimension additional to those of length, mass and time, or as a quantity of unknown dimensions in length, mass and time.

The first alternative is an additional complication to electromagnetic theory—it does no doubt simplify certain dimensional equations; the second is secured by the acceptance by the I.E.C. of the statement that 'μ_0 possesses physical dimensions'.

What is necessary to place the M.K.S. system on a secure basis is the realisation of the facts that the two quantities A and μ_0 are essential, and that if the units of the system are to be the practical units of the C.G.S. system, their values (unrationalised) must be 1 and 10^{-7} and (rationalised) 1 and $4\pi \times 10^{-7}$.

It must, of course, be recognised that another solution to the equation $A^2/\mu_0 K_0 = C^2$ is open to us. We may, with Gauss, put $A = C$ and then $\mu_0 K_0$ becomes a numeric.

Adolf von Baeyer, 1835-1917

By Prof. J. R. Partington, M.B.E.

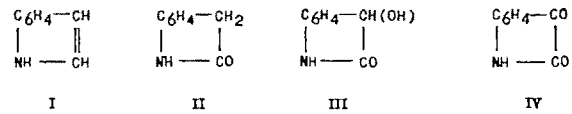
TWO of the outstanding organic chemists of the later nineteenth and early twentieth centuries were Adolf von Baeyer and his pupil Emil Fischer. As the late Prof. W. H. Perkin said, "their influence has been profound, mainly no doubt because of the immense amount of work of fundamental importance which they have left behind, but to a scarcely less degree by reason of their influence as teachers". The discoveries of Baeyer have also had a most important bearing on chemical industry, although he himself was little interested in their commercial exploitation. The side of theoretical organic chemistry which interested him most was the structural aspect, and in this his views, even in his early publications, were remarkably accurate. He modified in many ways the picture as left by Kekulé, and in some parts modern developments have merely filled in the details.

Adolf von Baeyer was born in Berlin on October 31, 1835. His chemical training began, like that of so many others eminent in this science, with Bunsen at Heidelberg. There he worked on cacodyl compounds, already made important in the early history of organic chemistry by the investigations of Bunsen. The latter had little interest in the development of organic chemistry at that time, and Baeyer, who wished to take up this branch of the science, spent two years in a private laboratory of Kekulé at Heidelberg. In 1858 he followed Kekulé to Ghent and began work on derivatives of uric acid. His interest in this was aroused in a curious way. During his journey from Heidelberg he became acquainted with a former pupil of Liebig, who gave him a box of specimens of uric acid derivatives. The further investigation of this class of bodies, carried out by Baeyer and his pupil Emil Fischer, may therefore be said to go back directly to the early work of Liebig at Giessen.

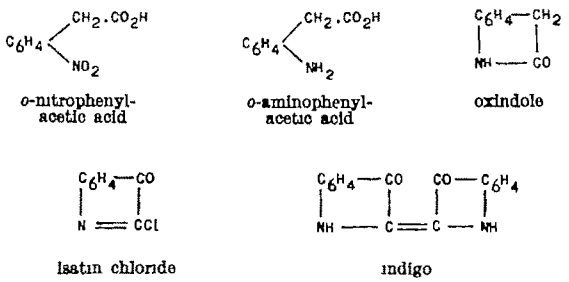
In 1860 Baeyer returned to Berlin as a teacher of organic chemistry in a small technical school. In this poorly paid and modest position he remained for twelve years, during which period he had in his laboratory such men as Graebe, Liebermann and Victor Meyer. The work on uric acid derivatives was continued, and in this period Baeyer also put forward the suggestion (in 1870) that the formation of sugar in plants is due to the reduction of carbonic acid, HO.CO.OH, in the green leaves and under the influence of light, to formaldehyde, H.COH, which then undergoes polymerisation to grape sugar, $C_6H_{12}O_6$. The study of a very important class of reactions called condensations began in 1866 with an investigation of the action of acids on acetone, and was developed in various directions, including the condensation of hydrocarbons with phenols and aldehydes. One outcome of this work was the use of phthalic anhydride, which led to the discovery of the phthaleins, many of which are dyestuffs, such as fluorescein, eosin and the rhodamines.

After a period from 1870 until 1875 at Strassburg, where Emil Fischer was his pupil, Baeyer succeeded Liebig at Munich. For more than twenty years, Liebig's activities at Munich had been confined to lecturing and studying the applications of chemistry to agriculture and medicine. There was no laboratory, and Baeyer's first task was to plan large new laboratories which were completed in 1877. In these he continued the investigation of indigo which he had begun in 1865, preparing several derivatives. He found that isatin (IV), a red substance discovered by Laurent in 1840 and produced by oxidising indigo with nitric acid, on reduction yields first dioxindole (III) and then

oxindole (II), which on distillation with zinc dust is reduced to the parent substance, indole (I):

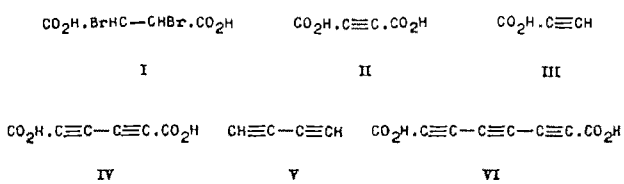


In 1870 Baeyer and Emmerling had found that isatin chloride when heated with phosphorus and hydriodic acid yields indigo, and thus when isatin was synthesised from *o*-nitrophenylacetic acid in 1870, this was also a synthesis of indigo:



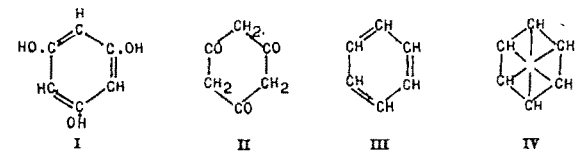
Several other methods of synthesising indigo were worked out in the period until 1885, and naturally the German dyestuff firms became interested in the matter. They spent great sums of money on research, but all the processes tried at first proved too expensive, and since Baeyer declined to take an active part in helping to solve the commercial difficulties, some ill-feeling developed on the side of the firms, which led Baeyer to terminate his researches on indigo altogether in 1885.

Baeyer then turned to the investigation of a series of interesting but dangerous compounds, the polyacetylenes. From dibromosuccinic acid (I) he obtained acetylene carboxylic acid (II), from which by removal of carbon dioxide he prepared propargylic acid (III). From this the compounds diacetylene carboxylic acid (IV), diacetylene (V) and finally tetracetylene dicarboxylic acid (VI) were obtained. The latter was very explosive.



The properties of these compounds led Baeyer to consider the nature of the triple bond and the stability of rings of carbon atoms, the result being announced in the 'strain theory', in which stability is related to the strain to which the valencies of carbon atoms, normally directed from the centre of the tetrahedron model towards the corners, must be subjected in the formation of closed rings. Although this theory has been to some extent modified by later work, the idea of a resistance to bending exhibited by carbon valencies has been fully substantiated.

In the period between 1884 and 1893 Baeyer published a mass of important work of very varied kind, including the proof that phloroglucinol can function either as trihydroxybenzene (I) or triketohexamethylene (II), a case of what was called tautomeric change, many examples of which Baeyer brought to light.



He also worked on partially reduced benzene rings, and made out the profound change in 'aromatic' properties which occurs when a ring is saturated with hydrogen atoms. This work led him to abandon the Kekulé formula for benzene (III) and to adopt the centric formula (IV), in which six valencies of the carbon atoms in the ring, instead of being linked in three double bonds, appear as six valencies directed towards the centre of the hexagon. This formula had been proposed by H. E. Armstrong.

Baeyer's work on the terpenes from 1893 until 1899 was important, although the theory was fully clarified only by Wagner and later workers. An oxidising agent used in this work was Caro's acid, which Baeyer and Villiger in 1900 showed was permonosulphuric acid, $HO.O.SO_2.OH$. This led to the study of organic peroxides, such as the benzoyl compound, $C_6H_5.CO.O.OH$, and the two ethyl compounds $C_2H_5.O.OH$ (unstable) and $C_2H_5.O.O.C_2H_5$ (stable), the second of which, on reduction, yielded two molecules of alcohol, hence pointing to the formula HO.OH for hydrogen peroxide.

At the age of sixty-six years, in collaboration with Villiger, Baeyer published a long and important series of researches on oxonium compounds, having become convinced of the truth of Collie and Tickle's interpretation of the salts of dimethylpyrone as containing basic oxygen, a view which he at first opposed. His last research, published in 1915, two years before his death, was on the pyrones and contains the first description of the oxonium colouring matters, which have such an important relation to natural pigments.

Baeyer's work covers a wide range, and it is practically all of fundamental importance.

Obituary

Dr. H. W. Dudley, O.B.E., F.R.S.

ON October 3, nearly three weeks after a serious operation, Harold Ward Dudley died in a London nursing home. His death was a peculiarly tragic one, for until a month before it occurred his friends had no reason but to expect that there lay ahead many fruitful and happy years for him. That this was not to be is a most serious loss to biochemistry, creates a deplorable gap in the ranks of a wide circle of acquaintances, and is a cause of unfathomable grief to his family and to his intimate friends.

The eldest son of Florence and the late Rev. Joshua Dudley, he was born at Derby on October 30, 1887, and educated at Truro College, King Edward VI Grammar School, Morpeth, and the University of Leeds, where he specialised in chemistry. That his career was so uniformly successful was due to a combination of rare gifts with happy associations.

It was Dudley's good fortune while at Leeds to come under the influence of that inspiring trainer of biochemists, the late Prof. Julius B. Cohen, and further, after taking the degree of M.Sc. by a thesis on optical activity in menthyl esters, to obtain an 1851 Exhibition research scholarship. In the choice of Emil Fischer's laboratory as the place in which to work during the tenure of this scholarship he was again well advised, and there, under the immediate guidance of Prof. Wilhelm Traube, he carried out an investigation on the then topical subject of the purines, for which he received the Berlin Ph.D. in 1912.

There followed what was perhaps the most important step in Dudley's career when, on his return from Berlin, he became an assistant in the Herter Laboratory, New York; there he not only carried out important work under the guidance of another former Leeds student, H. D. Dakin, but what was more, formed a friendship which he treasured throughout the remainder of his life. It is needless to enumerate their publications, for their work is well known to biochemists and others whom it concerns, but one might mention 'glyoxalase', which they discovered, and 'protein racemisation' which they investigated, both of which are known to every student of biochemistry, as an indication of the fundamental nature of their researches.

Returning to Leeds in 1914, Dudley was for about a year lecturer in biochemistry, but soon the insistent voice of war called for the application of his high gifts in the service of his country, and he did not hesitate to respond. On the formation of an anti-gas research department under the leadership of Lieut.-Colonel E. H. Starling, at the Royal Army Medical College at Millbank, Dudley began work with the rank of Lieut. R.E. early in 1916, and was soon assisting in the evolution of the small box respirator, and in many other ways giving his fertile mind to problems of chemical warfare. Having by 1918 acquired a large experience of the subject, he was sent, with the rank of Major, in charge of a responsible anti-gas mission to the United States. He fulfilled these duties with characteristic care and thoroughness, and made many and varied new friends. He was awarded the O.B.E. for these war services.

After the War he returned, not without relief, to biochemistry, as head of the Department of Biochemistry of the Medical Research Committee (since Council), and worked at the Lister Institute until, in 1919, the Council obtained possession of its premises at Mount Vernon. There he worked until September 5 last, and formed a happy and fruitful association with the director, Sir Henry Dale, and with many other of his colleagues.

It was during these years that Dudley's best and most mature work was done. His work on the active principles of the posterior lobe of the pituitary body, although it fell short of his own expectations and high standards of achievement, was none the less a masterpiece of technique and a monument of patience. Then, after the discovery of insulin, by Banting and Best, he and Sir Henry Dale went to Toronto and established important contacts there on behalf of the Medical Research Council. Afterwards his fine flair for chemical methods was illustrated by the introduction by him of the picrate method for the extraction of insulin, and for its ready purification. After other important work on the subject of the preparation of insulin, he was entrusted with the preparation of the first international standard of that substance. The work, carried out in collaboration with others, on spermine, histamine and acetyl choline as tissue constituents also represented fundamental contributions to biochemistry, and are illustrations of his wide knowledge and abundant resource in investigation. He was elected a fellow of the Royal Society in 1930.

Dudley's last research probably represented his most valuable contribution to knowledge, since it culminated in the discovery of the active alkaloid of ergot, called ergometrine. The last paper on this subject from his pen appeared in the *Proceedings of the Royal Society* on the day of his death. Although search had often been made for the constituent of ergot to which the contractions of the puerperal uterus which its administration occasions were due, it was shown by Moir that none of the hitherto known constituents of ergot was clinically responsible for this action. Dudley succeeded, in collaboration with Moir, who carried out the clinical tests, in isolating this new alkaloid, which, thanks to him, is now "by far the most readily accessible alkaloid of ergot", and is already on the market.

The list of Dudley's great services to biochemistry would be incomplete without reference to his work for the Biochemical Society: he acted as secretary

in 1922–24, and then became, jointly with Prof. Arthur Harden, an editor of the *Biochemical Journal*. In the performance of this arduous duty, which he continued for six years, it is true, as Boswell said of Johnson, that "That part of his labour which consisted in emendation and improvement of the productions of other contributors, like those employed in levelling ground, can be perceived only by those who had an opportunity of comparing the original with the altered copy". Certain it is that over this duty, and other editorial work as assistant editor of "British Chemical Abstracts", which he performed with equal care and thoroughness, he often worked far into the night, and over many of his week-ends. In 1921 he married Mary Nettleship, who, after prolonged illness, which was a source of the deepest sorrow to him, died as recently as last April. She was a great help to him in his editorial work, and those who heard her sing will long remember her beautiful voice.

Dudley was a keen fly fisher and of musical and artistic tastes. Though of a retiring disposition, he was always ready to place his wide knowledge at the service of others. He had a wide circle of friends and was a member of the Savage Club. Had he wished, he could have had many intimate friends, for his was a personality of rare charm. Those who were honoured with his close friendship will always treasure in their hearts the memory of his unselfish character, affectionate sympathy and characteristic placid wit, his patience in adversity and his intuitive penetration of all humbug. Our sympathy goes out especially to his mother, who had such good reason to be proud of him. C. A. L. E.

Prof. Rhoda Erdmann

THE death of Prof. Rhoda Erdmann, of Berlin, has deprived the scientific world of a distinguished research worker and a most notable personality.

Dr. Erdmann began her scientific career as a protozoologist. Shortly before the War, she went to the United States, where she collaborated with Woodruff in protozoological studies which are now classical. When the United States entered the War, Dr. Erdmann, as a German subject, became the victim of war-time hysteria. She happened to be investigating an organism pathogenic to mice only, when a serious epidemic broke out in a neighbouring military camp. She was accused of having secretly infected the troops with the organism she was studying, and was arrested and imprisoned in New York. Her scientific and medical friends in the United States rallied to her aid and eventually she was acquitted of the fantastic charge.

After the War, Dr. Erdmann returned to Germany and began to work with tissue culture, mainly on problems connected with tumour growth. She was appointed a professor of the University of Berlin and placed in charge of the new Institut für Experimentelle Zellforschung at the Charité. She developed the institute until it became one of the principal centres for tissue culture research in Europe. At the same time she set herself to organise experimental cytology throughout the world. The *Archiv für Experimentelle Zellforschung* was founded in 1925 at her instigation, and was edited by her until her death. She also conceived the idea of an international society of experimental cytology which should hold a triennial congress and of which the *Archiv* should be the official organ. This scheme she successfully accomplished, and thanks to her tireless efforts as general secretary three congresses have now been held, the third being at Cambridge in 1933.

The change of government in Germany involved Dr. Erdmann in much hardship and difficulty, and in 1933 the institute to which she had devoted so much labour and care was closed, and she was pensioned. This was a great grief to her as she lived for her scientific work. She was accordingly delighted when in December 1934 the German Government decided to open another institute for experimental cytology under her directorship. Her health, which had troubled her for many years, was failing rapidly, but with undaunted courage and enterprise she began the task of creating her institute anew in a set of empty rooms in a private house. This task she was not destined to complete, and on August 23 she died at the age of sixty-four years.

Perhaps the quality which most endeared Dr. Erdmann to her friends was her gallant spirit. Oppressed by burdens of mind and body which many would have found overwhelming, she never lost heart but continued to work and plan for the future with the energy which characterised all she did. To those of us who knew her well, her death is a personal loss.

H. B. F.

DR. HYNEK VYSOKÝ, professor of classical archæology in the Charles University, Prague, died at Rychnov, his birthplace in north-east Bohemia, on August 27, at the age of seventy-four years. He was educated at Prague and Berlin, and afterwards studied in Italy, Greece and Turkey. He wrote a number of Czech and German works on Greek archæology and mythology, and compiled most of the material dealing with archæology in Otto's (Czech) "Encyclopædia".

WE regret to announce the following deaths:

Prof. Carl Barus, emeritus professor of physics in Brown University, Providence, R.I., known for his work on interferometry and acoustic pressures, on September 20, aged seventy-nine years.

Mr. F. Escombe, who collaborated with Mr. H. T. Brown in noteworthy investigations on photosynthesis, on October 12, aged sixty-three years.

Major-General A. W. Greely, known for his geographical work in the Arctic, aged ninety-one years.

Dr. Walter Hough, head curator of the Department of Anthropology in the U.S. National Museum, on September 20, aged seventy-six years.

Mr. Joseph A. Johnson, president of the American Institute of Electrical Engineers in 1934, on October 5, aged fifty-three years.

News and Views

The E.R.A. Laboratory at Perivale

ON October 22, the Duke of Kent opened the new laboratory of the British Electrical and Allied Research Association which has been built at Perivale, Middlesex. Referring to the importance of research, he said that, in a mechanical era such as ours, it is one of the most important features of productive industry. The Association is supported by the Department of Scientific and Industrial Research, the Institution of Electrical Engineers, the British Broadcasting Corporation and many other bodies, including electric supply undertakings in the dominions and colonies. Electrical manufacturing firms are now well-equipped with laboratories for conducting research into problems bringing immediate profit to themselves, and they spend in this way hundreds of thousands of pounds a year. The Research Association conducts researches of general interest, which are of benefit to the user of electricity (the public), the user of electrical plant and apparatus (the electricity supply undertakings and the public) and to the manufacturer who uses electrical materials. The research work is carried out under the guidance of its council and seventy-five technical committees consisting of 450 leading experts in all branches of the industry who give their services voluntarily. The research work as a whole is supervised by the director, who is assisted by a staff of forty-seven technical experts and thirty-two clerical workers. Most of the work is done in existing establishments, the National Physical Laboratory, universities, manufacturers' laboratories, etc., but where special facilities are required it is carried out by the technical staff.

THE Association's new laboratory has a total floor space of about 14,000 square feet; but there is room for increasing the staff without further extension of the premises, and the site is capable of further development. The power frequency and heavy current laboratory contains a trench specially constructed for tests on cables laid horizontally. The standardising laboratory, physics laboratory, and generator room are also on this floor. In the east wing are situated laboratories which are specially equipped for researches on heavy current circuit breakers. The west side contains the radio and telephone laboratories, high-voltage laboratory, chemical laboratory, workshop and main store. The plant comprises a 230 volt–450 ampere hour battery which is charged automatically during the night by a mercury arc rectifier, and its output voltage is controlled by an automatic voltage regulator. Over each investigator's bench there is a small switchboard from which any of the numerous A.C. or D.C. circuits can be obtained. The high-tension laboratory is equipped for tests up to 80,000 volts. The heating plant is operated automatically, and burns a cheap grade of coal. The laboratory has been designed with a view to economy and efficiency. The night and week-end temperature is automatically maintained at a somewhat lower value than the thermostatically controlled temperature of the working period.

Bridging the Gap: Metropolitan-Vickers Laboratories

BETWEEN the abstract idea of an invention, or new scientific knowledge, to demonstrated utility, there is generally a wide gap, and to bridge this gap much work has to be done in special research laboratories. At the end of the War, Metropolitan-Vickers was one of the first large industrial organisations to realise the great part which scientific research would play in the development of industry. The building of the research laboratories, which now have a floor area of more than 40,000 square feet, was commenced in 1920. A rule has been made that all materials and products which enter the company's works as 'raw materials' must be subjected to test by the Research Department. As this Department is in close touch with the works and factories which develop the raw materials, these tests have been a great help to suppliers in improving their products.

THE Research Department is organised into a series of sections which form one co-operative whole, and this enables each problem to be investigated rapidly in the most efficient way. The four main buildings may be roughly described as the chemical, mechanical, high-tension and physical laboratories. Photographs of some of the apparatus used in making tests is shown in the pamphlet. Many of the machines used are unique; some of them incorporate the latest methods devised by scientific workers, and there are few machines in Great Britain which rival them in size. We were much impressed by the photograph of the M.V. 500 kw. wireless valve, installed at Rugby and continuously evacuated by M.V. oil condensation pumps and a single rotary pump. In the library section, current scientific, technical and economic literature is scrutinised and translations are constantly being made from many languages.

The Mitten Crab in English Rivers

IN the review of Peters and Panning's "Monograph of the Mitten Crab" published in NATURE of June 9, 1934, an account was given of the invasion of European rivers by this Chinese species, and the probability of its spreading to English rivers was pointed out. This seems now to have come to pass. About a fortnight ago, a living specimen was found on one of the screens guarding the pipes through which water is pumped from the Thames into the condensers at Lots Road Power Station in Chelsea. It is a full-grown male, the carapace measuring 63 mm. in length, by 68 mm. in breadth. The exact way in which the species has reached Great Britain is

a matter for conjecture, but the possibilities of transport from the estuaries of Holland or North Germany are obvious. Some highly coloured forecasts have appeared in the daily Press regarding the damage likely to be caused if the crab becomes established in English rivers and estuaries. It can safely be said, however, that there is little ground for apprehension. On the Continent, the banks of rivers have been undermined in places by the burrows of the crabs, but the most serious damage has been caused to fresh-water fishes. In Great Britain, where fresh-water fish have for the most part only a sporting value, the new addition to the fauna may justify some anxiety on the part of anglers in the eastern counties. There is fortunately no reason for anticipating that the crab will introduce into Europe the lung disease, paragonimiasis, of which it is one of the vectors in the Far East.

Association of British Chemical Manufacturers

THE nineteenth annual report of the Association of British Chemical Manufacturers, submitted to the annual meeting on October 10, records an increase in membership from 109 to 118, while the number of affiliated associations is now 13. Reference is made to the participation of the Association in the Brussels International and Universal Exhibition, the British Chemical Exhibit at which has been organised by the Association at the request of the Department of Overseas Trade. The safety activities of the Association have been continued, and the Association has submitted a list of solvents in general use as a basis for the investigation, which has now been commenced by a special committee under the Medical Research Council, on their physiological effects in relation to industrial risks. The investigation on tests for the detection of low concentrations of toxic gases that are likely to be encountered in industry, to which the Association has contributed half the cost, is nearing completion. Methods of detection and estimation, usually with test papers, have been worked out and standardised for a number of gases by the Chemical Defence Research Department, and a printing method has been discovered which will give consistent results and yield permanent stains. The Association is also supporting financially work on the testing of respirators for industrial use to ensure that they give adequate protection, which is being carried out by the Chemical Research Department. The Association has taken over from the Chemical and Allied Employers' Federation the regular collection and investigation of accident statistics as part of its normal safety activities. Other matters on which action has been taken during the year relate to the Provisional Poisons List and Poisons Rules and the report of the Poisons Board, trade marks, Government patents and the transport of chemicals by road.

IN moving the adoption of the report at the annual meeting, Mr. T. Wallace, who deputised as chairman in the absence of Dr. F. H. Carr, through illness, referred particularly to the manner in which the Government left the chemical section of the Polish Treaty to be worked out between the Association and the Polish Union of Chemical Industries. The importance of industrial reorganisation was stressed, particularly the necessity for further co-operation in regard to research, production and marketing. Commenting on the position of the fine chemical industry, Mr. Wallace said that since the report was written a supplementary memorandum has been submitted to the Key Industries Committee of the Board of Trade, detailing reasons why the manufacturers considered the progressive development of the industry would be better assured by a continuance of the key industry duties than by a transfer to the Import Duties Act.

Roman Yorkshire

As progress is made in the excavation of the Roman villa at Rudston, six miles west of Bridlington in Yorkshire, it affords a more extended view of settled life under what has been termed the 'signal-station' system, which archæological discovery in this area has revealed as a characteristic feature in the organisation of this section of Roman Britain. The site has now been under investigation for three seasons by a local committee in conjunction with the Roman Antiquities Committee of the Yorkshire Archæological Society, the excavation being in charge of Messrs. A. M. Woodward and K. A. Steer. Both coins and types of pottery point to an occupation of considerable duration, the former ranging from Domitian to Valens, and the latter including late first century, Samian, third century types from the Yorkshire pottery at Throlam and 'signal-station' types of the end of the fourth century. A system of pre-Roman ditches below the foundations may go back so far as the Bronze Age. An interesting building to the west of the residential block, discovered in 1934, which measures not less than 50 ft. by 22 ft., is now seen, according to a report of the latest results of excavation (*The Times*, Oct. 22), to have been used for a variety of purposes connected with the needs of the villa. *Tesserae* of sandstone not of local origin, and many chippings of chalk and tile, confirm the view suggested by earlier discoveries of chalk *tesserae* and red and blue tiles that it was a workshop for making and repairing mosaic flooring. Further, remains of no less than six ovens point to other uses not yet completely apparent. An early suggestion that they were part of the equipment for the manufacture of wool or for tanning has now been abandoned in favour of the view that they were for drying or roasting grain preparatory to grinding.

The College of Science, Benares Hindu University

FEW countries are, in proportion to their literate population, so well equipped with modern laboratories as India. The reproach can no longer be levelled at Indian university education that it is purely literary. We need only cite as examples the fine laboratories to be found at the University College of Science, Calcutta, the Presidency College, Madras, and the Royal Institute of Science, Bombay. From the time of its foundation in 1911, the Hindu University at

Benares has paid particular attention to the teaching of science, both pure and applied. The science departments with a staff of seventy provide accommodation for about one thousand students, and these departments have now been constituted a separate College of Science within the University. This College, of which Prof. K. K. Mathur has been appointed the first Principal, was formally opened on September 12 by the veteran Vice-Chancellor and founder of the University, Pandit M. M. Malaviya. In his opening address, the Vice-Chancellor emphasised the need in the present economic position of India for increased facilities for the study of science in all its branches. The Hindu University has already played a prominent part in the industrial development of the United Provinces, and we are sure that the foresight of the Vice-Chancellor and executive body of the University in establishing this new college will lead to an expansion of its activities.

New German renderings of 'Foreign' Words

IN NATURE of September 28, p. 495, we published a short notice of the second edition of "Theoretische Physik" by Dr. Georg Joos. Our reviewer commented very favourably upon the book, but animadverted upon the addition of a glossary of "foreign" words (*Erläuterung einiger Fremdwörter*), "in which *Absorption* (*Verschluckung*), *Elastizität* (*Dehnbarkeit*), *Kapillarität* (*Haarröhrchenkraft*) and such-like non-Prussian words are translated into the new German, although these 'foreign' words appear in the articles in Gehler's 'Physikalisches Wörterbuch' of more than a hundred years ago". We have now received an indignant letter from Dr. Joos, containing the following explanation of this glossary. "Many English readers, who according to the reporter are to be impressed comically through these things, will know that the graduates of the 'Oberrealschule' have studied neither Latin nor Greek and that for them an explanation of these words is very desirable", adding, "According to the wording of the report the reader must think that it is my intention to seriously substitute 'Verschluckung' for 'Absorption' or 'Segelstange' for 'Antenne' ". As regards the last sentence our reviewer suggested nothing about Dr. Joos' intentions, but stated the bare fact that the glossary had been added to the book, leaving his English readers free (if we may use the word without offence) to draw any conclusions they wished. Many will, no doubt, share his and our surprise that words which have been in regular use in the German language for four generations and more, a period sufficient, we should have thought, to guarantee their incorporation, should be regarded and named as foreign.

OUR reviewer adds: "We note that graduates of the Oberrealschule have studied neither Latin nor Greek, but then they did not do so at the time of the first edition, which did not contain the glossary; in fact, they never did. Most students in England and other countries are equally unfamiliar with Latin and Greek, but have no difficulty over 'elasticity' and 'capillarity', while Germans unfamiliar with French have, we believe, no difficulty over '*General*' and '*Soldat*'. Dr. Joos does not seem to realise that, if there is any force in his contention, most German students will not know what his book is about, since both '*Theoretische*' and '*Physik*' are Greek words not explained in the *Erläuterung*. For that matter, *Electricität* (may we suggest *Bernsteinreibungskraft ?*) is not in the glossary, although *Kapazität* (*Fassungsvermögen*) is: *Alkali* (a Semitic word which occurs in the book combined with a Latin word as *Alkalispektren*—shall we suggest *Pflanzenaschenerdelichterscheinung ?*) is missing, although *Kondensator* (*Verdichter*) is included. We hope in the next edition to see the glossary either omitted or properly completed. We in England find so much in the present-day activities in German universities to move us to tears that Dr. Joos really must allow us a faint smile when we come across something harmlessly amusing from that quarter, and permit us to be our own judges of what is 'comical' ".

International Exhibition of Nature Photography

THERE was a large assembly of naturalists and Nature photographers at the opening on October 16 of the *Country Life* International Exhibition of Nature Photography at the British Museum (Natural History), Cromwell Road, South Kensington. The Earl of Onslow, president of the Society for the Protection of the Fauna of the Empire, referred to the great value of Nature photography and cinematography as "a very powerful incentive towards the preservation of wild life in all its forms", and to the fact that the Exhibition contains a large number of subjects that have never been seen before. He went on to remark that "there is a very grave danger at present hanging over us and that is that unless wild animals, big-game and birds of all kinds are carefully preserved a great number of species will become extinct and they will be a downright loss to the world in general. We could do without poison snakes but most other animals are a very valuable asset not only from the natural history point of view, but from the scientific point of view and from the point of view that they tend to preserve the balance of Nature." The audience, which included, among many others well known for their interest in wild life, the Duke of Sutherland and Lord Desborough, afterwards inspected the Exhibition. More than thirteen hundred photographs are displayed on screens in the Whale Hall, one wall being devoted entirely to the work of pioneer photographers, which includes the late J. H. Symonds' picture "Goldfinches fighting on Teazle", "Marsh Harrier" by the late Col. H. Moore, and no fewer than seventeen fine studies by Mr. C. J. King. The Exhibition will be open—admission free—until November 30. A souvenir volume (5*s*.), containing reproductions of 120 pictures from the Exhibition, has been published.

Edwin Klebs

IN a centennial note published in the *New England Journal of Medicine* of July 11, Dr. Leona Baumgartner, of Cornell University Medical College, New York, claims that Edwin Klebs, who was born

on February 6, 1834, and died in 1913, was not only one of the pioneers of bacteriology, but also made important contributions to other fields of medicine. In addition to being the first to describe the causal organism of diphtheria in 1875, he described acromegaly in 1884, two years before Pierre Marie; inoculated primates with syphilis fifteen years before Metchnikoff; isolated colonies of bacteria on solid media in the form of Sturgen's glue nine years before Koch; was the first to produce tuberculosis experimentally in animals by the injection of milk from infected cows, thereby establishing the bovine origin of the disease; and described the typhoid bacillus before Eberth. Klebs pursued his medical education in his native town of Königsberg under Rathke, Helmholtz, Burdach and Werther, and later in Wurzburg under Virchow, Kolliker, Leydig and Scanzoni. He led a wandering life, being successively professor at Berne, Wurzburg, Prague, Zurich and the Rush Medical College, Chicago. His contributions to pathological anatomy and physiology included the first experimental production of valvular disease of the heart and the recognition of bacterial infection in the production of the subsequent endocarditis, the description of hæmorrhagic pancreatitis as a rapidly fatal disease, the introduction of the paraffin embedding method and his textbooks on pathological anatomy (1869–76) and general pathology (1887–89). Klebs also took an active part in the foundation of three important medical journals, namely, the *Correspondenz-Blatt für Schweizer Aerzte* (1871), which some years ago was renamed *Schweizer medizinische Wochenschrift*, the *Archiv für experimentelle Pathologie und Pharmakologie* (1873) and the *Prager Medizinische Wochenschrift* (1876).

Work of the Government Chemist

THE report of the Government Chemist on the work of the Government Laboratory for the year ending March 31, 1935 (London: H.M. Stationery Office, 9*d*. net), outlines the work carried out in the Government Laboratories for the Admiralty, Ministry of Agriculture and Fisheries, the Air Ministry, Crown Agents for the Colonies, Board of Customs and Excise, Ministry of Health, Home Office, Post Office and other Government departments. The total number of samples examined during the year was 522,788, as compared with 503,592 in the previous year. There was an increase of 26,594 in the number of samples examined in the laboratory at Clement's Inn Passage, and decreases at the Custom House laboratory and at the chemical stations of 232 and 7,166 respectively, the latter being due to the closing of the Manchester chemical station and the transfer of the examination of samples of tea to tea inspectors of Customs and Excise. The principal increases occurred in the number of samples of hydrocarbon oils, beers, wine, spirits, cocoa and chocolate, samples for duty under the Import Duties Act, 1932, Safeguarding of Industries Act, 1921, tobacco and silk exportations, samples of sugar composite goods and British sugar, and in samples taken under the national marking schemes.

THE hydrocarbon oils duty has involved the examination of nearly 17,000 samples for assessment of duty on importation or drawback of duty on exportation, the increase being due to the duty of 1*d*. per gallon charged on oils other than light oils. Many of the samples had to be examined for other dutiable substances, such as alcohols, esters and chemicals listed by the Board of Trade under Part I of the Safeguarding of Industries Act. The growing use of duty-free spirits and industrial methylated spirits in industry involves an increase in the consultative work of the Laboratory, apart from the examination of samples to ascertain whether the conditions of use laid down by the Commissioners of Customs and Excise have been fulfilled. The number of samples of cocoa, chocolate and wine submitted for examination increased by 1,400; samples of beer increased by 1,609, of silk and rayon by 1,866, while the Laboratory was also called upon to deal with the testing of animal and vegetable fibres and hairs of all kinds under the Import Duties Act. The number of samples of tobacco and snuff examined has also increased, and improved methods for the analysis of tobacco have been studied. Much work has been carried out on the revision of existing methods and the investigation of new methods of detection and determination of substances.

Petroleum and Tar Oils as Insecticides

AN important paper by Dr. Hubert Martin on the standardisation of petroleum and tar oils and preparations as insecticides appears in the *Annals of Applied Biology* (**22**, 334). In recent years, a great deal of attention has been devoted by research workers and by the appropriate Government departments to the standardisation and specification of the sprays and dusts employed for the control of insect pests and diseases infesting agricultural and horticultural crops. An important body of knowledge on the chemical constitution and physical properties of these materials is scattered through the literature of the subject, and is so extensive as to be available only to relatively few. Of the many insecticides now in use, the petroleum and tar distillate oils occupy a very important position, and their use, already widespread, is expanding. Dr. Martin gives an extended and critical review of the published information of the chemical and physical factors defining these products, and in addition incorporates much original work of his own.

DR. MARTIN sets out in a concise and ordered way how the chemical and physical criteria can be correlated with insecticidal and phytocidal properties, and finally builds up from his own analyses specifications which he considers are available for judging the suitability of these oils, and preparations made from them, for their various uses as insecticides. In addition, the analytical methods available are considered, and the most suitable set out with supporting evidence in considerable detail. This paper is an important step towards the realisation of the hope, that a reasonable standard of efficiency and safety in use

and of uniformity of quality may be attained for these important products. It is published with the object of ascertaining how the various specifications will work out in practice, and thus it is advisable that interested manufacturers, horticultural advisers, and large users will give it the attention it deserves. The Council of the Association of Applied Biologists has consented to the paper being reprinted for sale, the price being 2*s*. post free; it is obtainable from the author (Research Station, Long Ashton, Bristol).

International Congress of Mining, Metallurgy and Applied Geology

THE seventh International Congress of Mining, Metallurgy and Applied Geology was opened at the Sorbonne, Paris, on October 20, and will continue until October 26. The President of the Republic, M. Lebrun, was present at the inaugural session. Sir Robert Hadfield, the delegate of the Iron and Steel Institute, presented to M. Lebrun a copy of the picture in the Bodleian Library, Oxford, depicting Roger Bacon presenting a book to the Chancellor of the University of Paris. Sir Robert also presented a miniature knife of steel made by Michael Faraday during the years 1819–24 while he was residing at the Royal Institution. The steel contains 0·74 per cent platinum. The weight of the blade is one-hundredth of an ounce, and that of the complete knife, one-twentieth of an ounce. Sir Robert suggested that the knife should be handed either to Dr. Leon Guillet, head of the Ecole Centrale des Arts et Manufactures, or to the Ecole des Mines.

Pasteur Institute of India, Kasauli

IN the thirty-third annual report for 1933 of the Kasauli Pasteur Institute, the Director, Lieut.-Col. Shortt, gives an account of the work of the Institute for 1933. The total number of patients attending the Institute and its various centres was 19,524, an increase of 4,406 as compared with the previous year. Such a large number of patients indicates the widespread threat of rabies in India. The vaccine used was carbolised 5 per cent Paris sheep vaccine, and three out of every four cases with face bites received antirabic serum in addition, as this appears to improve the results obtained. Deducting some 2,000 cases that did not complete the treatment, and 1,446 cases whom it was considered did not require treatment, there were 1,356 Europeans and 14,582 natives treated. There were no deaths among the Europeans, and 83 deaths among the natives, a combined percentage death-rate of only 0·52.

Australian Statistics

THE Official Year Book of the Commonwealth of Australia for 1934 (Commonwealth Bureau of Census and Statistics. 5*s*.) gives as usual an exhaustive summary of all aspects of Australian life and activity. The call of economy still hampers the editor in carrying out all his projects, but he has achieved great success in presenting information in forms that are useful to economists and others. Many details of the census of 1933 are incorporated. An appendix gives a summary of the chief events in connexion with the financial crisis that began in Australia in 1929.

Craftsmanship in Scientific Instruments

THE Physical Society announces that the seventh annual craftsmanship and draughtsmanship competition will be held as usual in conjunction with its annual exhibition of scientific instruments and apparatus in January next. Competitors must be in the regular employ of a firm or institution which will be exhibiting or has exhibited at least once during the previous three years, and has been invited by the organising committee to enter its employees for the competition.

Chinese Medical Association

THE third general meeting of the Chinese Medical Association, the official medical association of China, will be held on November 1–8. This association is the successor to the China Medical Missionary Association organised in 1886. The 1935 meeting will be held at the Canton Hospital, Canton, China, because it was here that Dr. Peter Parker introduced Western medicine into China one hundred years ago. He was also the world's first regularly appointed medical missionary. A centennial "History of the Hospital" is now in the press (Kelly and Walsh, Shanghai). Besides the regular scientific sessions of the conference, November 2 will be devoted to the centenary celebrations. The new Canton Hospital will be formally opened, and the foundation stone will be laid for the new medical school building. The money for the latter has been obtained by a special grant from the Central Executive of the National Government of China.

New Secretary of the Institution of Naval Architects

MR. G. V. BOYS has been appointed secretary of the Institution of Naval Architects, in succession to Mr. R. W. Dana, who will retire at the close of this year, after thirty-four years of service as secretary. Mr. Boys, who is a son of Sir Charles Vernon Boys, is a graduate of Trinity College, Cambridge (Mathematical Tripos, Pt. 1, and Mechanical Science Tripos). He is an associate-member of the Institutions of Mechanical and Electrical Engineers, and was for some years a demonstrator in mathematics and mechanics at the Imperial College of Science and Technology; previous to this he was one of the founders of the University of Cambridge Engineering Society. For the past fourteen years he has been on the staff of Messrs. Kennedy and Donkin (consulting engineers).

Royal College of Physicians

THE annual Harveian Oration was delivered on October 18 at the Royal College of Physicians by Sir Henry Dale, director of the National Institute for Medical Research, whose subject was "Some Epochs in Medical Research". The substance of the lecture is printed on p. 690 of this issue. The president of the Royal College of Physicians, Lord

Dawson of Penn, afterwards presented the Baly Gold Medal to Dr. F. H. A. Marshall and the Bisset-Hawkins Gold Medal to Sir George Newman, lately Chief Medical Officer of the Ministry of Health. The Baly Medal is awarded annually for distinction achieved in the science of physiology. The Bisset-Hawkins Medal is awarded triennially for "such work in advancing sanitary science or in promoting public health as in the opinion of the College deserves special recognition".

Care of Cripples and Invalids

A JOINT conference of the Invalid Children's Aid Association and the Central Council for the Care of Cripples will be held on November 7–8 at the Drapers' Hall, Throgmorton Street, London, E.C. The opening address will be given by the Minister of Health, Sir Kingsley Wood. The subjects for discussion will be: (1) infectious diseases and their after-effects; immunisation and other preventive measures; (2) the problem of physical handicap in modern life; (3) the after-effects of accidents; rehabilitation. Visits will also be paid to various homes and hospitals. The Conference fee, including the report of the proceedings, is 7*s*. 6*d*., and should be sent to Miss Wynne (Invalid Children's Aid Association) or Miss Nangle (Central Council for the Care of Cripples), Carnegie House, 117 Piccadilly, W.1, from whom further information may be obtained.

Announcements

SIR ALBERT HOWARD, formerly director of the Institute of Plant Industry, Indore, will deliver a lecture entitled "The Manufacture of Humus by the Indore Process", before the Royal Society of Arts on November 13 at 8 p.m.

PROF. HERMANN LEVY will deliver the Sidney Ball lecture in the University of Oxford on October 29 at 5 p.m. He will take as his subject "The New Aspects of Industrial Combination" and the lecture will be given in the Examination Schools, Oxford.

THE Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's new hall in Greycoat Street, Westminster, on November 5 and November 26, at 3.30 p.m., by Sir William Wright Smith, on "Problems connected with the Classification of Plants". Sir Arthur Hill and Sir Daniel Hall have consented to take the chair on these occasions.

PROF. GREGORIO MARANÓÑ, president of the Spanish Academy of Medicine, has recently been elected president of the Hispano-Belgian scientific *entente* committee.

DR. FRITZ LENZ, professor of racial hygiene, University of Berlin, has been awarded the Josef Schneider medal by the medical faculty of the University of Würzburg.

A COMMITTEE has been formed for the erection of a monument at La Ciotat, by the sculptor Paul Gondard of Marseilles, to the brothers Louis and Auguste Lumière, who were the first to exhibit cinematograph films in September 1895.

ON the occasion of the fiftieth anniversary of the first inoculation for rabies on July 20, a bust of Pasteur was unveiled at Havana in a square to which his name had been given, on the initiative of the academy of Sciences of Havana, in conjunction with the Franco-American Committee of Paris.

PROF. WILHELM HABERLING, of the Düsseldorf Academy of Medicine and joint editor of *Mitteilungen zur Geschichte der Medizin, der Naturwissenschaften und der Technik*, has recently been awarded the Sudhoff medal by the German Society of the History of Medicine for his eminent services to the study of the history of medicine.

VICTOR COUSIN in 1848 described at length a MS. of the Abbey of Corbie now in the Municipal Library of Amiens, which contained a number of treatises by Roger Bacon, written while he was teaching in the University of Paris. Under the title "Opera Hactenus Inedita Rogeri Baconi", the Oxford University Press is publishing shortly the last—the thirteenth—of a series of fasciculi, completing the publication of these treatises, which represent the teaching of the Faculty of Arts in the first half of the thirteenth century. The editors are Mr. Robert Steele and the Rev. Père F. M. Delorme.

THE Royal Commission for the Exhibition of 1851 has re-issued its list of whole-time awards for scientific research, other than professorships, offered by public and private bodies in Great Britain and Northern Ireland. The list does not include awards of value less than £150 a year, neither does it include awards offered by universities and scientific societies exclusively for the benefit of their own members. The list, which brings together in convenient form a good deal of useful information, can be obtained from the Secretary of the Commission, 1 Lowther Gardens, Exhibition Road, London, S.W.7, price 6*d*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A senior assistant to the principal (also to teach mechanical engineering) in the Barrow-in-Furness Technical College—The Director of Education, Town Hall, Barrow-in-Furness (Nov. 4).

An assistant (III) at the Fuel Research Station, East Greenwich and a junior scientific officer at the Chemical Research Laboratory, Teddington—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Nov. 5).

A senior lecturer in mathematics, and lecturers in mechanical and civil engineering in the Lester School and Institute, Shanghai—The Lester Trust, c/o Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (Nov. 30).

A lecturer in mechanical and civil engineering in the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 686.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of Skeletal Movement

FIGS. 1 and 2 reproduce photographs of a model demonstrating a type of skeletal movement which depends upon automatic adjustments of hydrostatic pressure acting upon an elastic body wall. Neither muscular nor nervous mechanism is demanded. These skeletal movements, according to investigations I have made recently, appear to have characterised some of the Cambrian Cystoidea—the earliest and most primitive of all the Echinodermata. The automatic adjustments of body wall and skeleton, it is suggested, were brought about by varying ciliary activity during the rise and fall of the tide.

The model consists of a football bladder, representing the elastic body wall of the animal. Upon this are fixed a double row of oblong thin blocks of rubber representing a portion of the food grooves. Fig. 1 shows the body collapsed and the grooves closed. Air blown into the bladder (Fig. 2) increases the tension on the elastic wall. This causes a pull on fibres attached to the blocks and to the body wall. The blocks, working on the hinge of attachment to the wall, are pulled over and the groove opens.

The place of air as a means of inflation was taken, in the lifetime of the Cystid, by water introduced into the body through the stone canal (here the neck of the bladder). Cilia in the stone canal drove a water current through it and so increased the hydrostatic

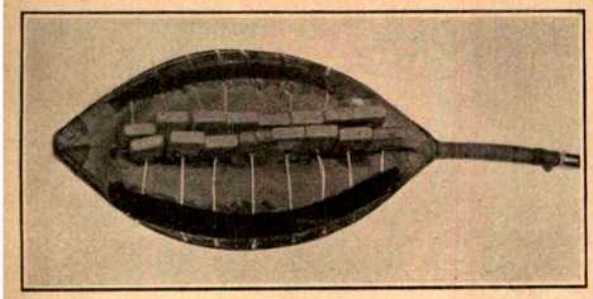


FIG. 1.

pressure. A change of conditions (suggested below) caused the ciliary movement to cease. The elastic tension of the body wall would reverse the current, force water out through the stone canal, with consequent collapse of the form and closure of the groove again.

The suggested mechanism fits in with what is known of the state of preservation of the fossils and the conditions under which the beds containing them were deposited. *Stromatocystis* found in the Lower and Middle Cambrian affords a good example. The Lower Cambrian beds of Newfoundland, in which

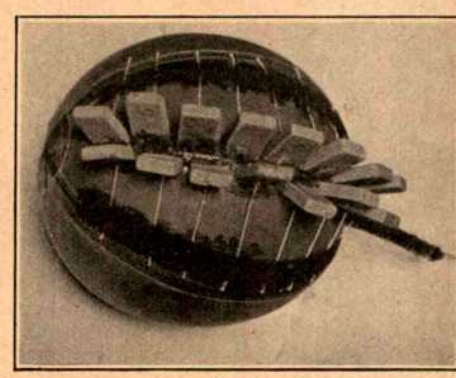


FIG. 2.

forms were discovered by Schuchert, have, as that author has shown, rain pits and all the other evidences of shallow water deposition. All the specimens of *Stromatocystis* both from Newfoundland and Bohemia (Middle Cambrian) which I have examined show the body collapsed and the groove closed. Related forms from deeper waters show an open groove and a firmer skeleton. Comparison of these various forms suggests that the collapsible skeleton and groove of *Stromatocystis* was adapted to intertidal conditions. When the tide came in, freshly aerated water would be brought in, which would stimulate the cilia of the stone canal. The animal would swell, rise above the surface of the sand, the groove would open and the animal begin to feed. After the tide had retreated, the water immediately around the animal's body would become saturated with carbon dioxide, the cilia would cease motion and the animal would collapse into the wet sand which would preserve it from desiccation.

Gray[1] has described a somewhat similar phase in the feeding periods of *Mytilus*, and it is because of this work that I am venturing these views, which do much to clear up many difficult points in Cystid structure.

W. K. SPENCER.

Ipswich.
Sept. 25.

[1] "Ciliary Mechanisms".

Infra-Red Spectrum of Hexadeuterobenzene and the Structure of Benzene

IN our letter in NATURE of June 22 (p. 1033), we referred *inter alia* to our measurements of the Raman and infra-red spectra of C_6D_6, but did not give the infra-red results, as a collective publication of this and other spectra was projected. In the August number of the *Journal of Chemical Physics* (p. 446), Barnes and Brattain have now reported some infra-red measurements[1], and we therefore cite our own data for comparison. The principal frequencies (cm.$^{-1}$) are in Table 1, but we omit the record here of the numerous very weak bands, obviously combination tones, which form an almost continuous background to the spectrum. Intensities are roughly indicated by asterisks. Our complete map of the spectrum shows much less background than appears in Barnes and Brattain's graph, but except for this and the deviations in the extreme frequencies, the agreement is good so far as the ranges overlap.

Table 1.

Assignment	C_6H_6	C_6D_6		Assignment
	Literature	B. and B.	This note	
$A2u$	669 **	—	671 *	
	1030 ***	797	817 ****	
	1483 ***	1147	1150 *	
Eu	1620 *	1321	1334 **	Eu
	1780 **	1439	1448 **	
	1950 **	1608	1610 *	
	3073 **	2294	2246 ***	
	4070 *	—	2985 *	

[The unassigned frequencies are assumed to be combination tones.]

In our previous note we showed that an analysis of the Raman frequencies of C_6H_6 and C_6D_6 with the aid of Teller's product theorem[1] permitted an unequivocal assignment of frequencies to the proper vibrations of the plane hexagonally symmetrical model of benzene. We shall now show that a similar statement is true for the infra-red spectrum. The model requires four infra-red fundamentals divisible into two symmetry classes as shown in Fig. 1. Class $A2u$ consists of one hydrogen vibration perpendicular to the ring; class $E\bar{u}$ contains three degenerate vibrations in the plane of the ring. The product theorem gives, for the (H/D)-quotient of the products of frequencies of like symmetry, $\tau(A2u) = 1{\cdot}36$, $\tau(E\bar{u}) = 1{\cdot}93$, and these figures, together with consideration of the intensities of the bands, lead to the assignment indicated in Table 1. The work is incomplete as it is unsatisfactory to have to identify the $A2u$ benzene frequency by exclusion: search for the corresponding C_6D_6 frequency (at ν 491) requires a modification of apparatus, to effect which will take some time.

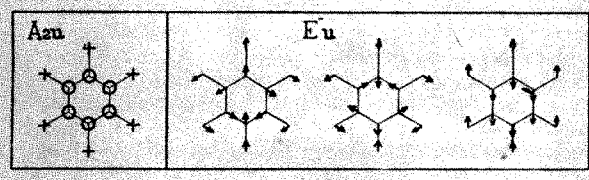


FIG. 1.

The reason which led many physicists to reject the plane hexagonally symmetrical benzene model was the appearance of coincident frequencies in the Raman and infra-red spectra: it was assumed that these were coincidences of principle and not of accident, and the conclusion then followed inescapably by Placzek's theory that no centre of symmetry was present. An immediate result of our work is *that certainly all but one, and very probably all the coincidences, are accidental.* They are shown (with the very generous allowance of 40 wave-numbers) in Table 2. Of the four in C_6H_6, three disappear in C_6D_6. One new one appears, but it was not present in C_6H_6. Only one (marked *) remains common, and apart from the poor agreement of frequencies, it occurs in a region where (as Dr. Placzek pointed out to us) accidental coincidences would be expected owing to the relatively weak coupling of individual C–H stretching vibrations. Thus no good reason remains for rejecting the benzene model which chemists prefer.

Table 2.

C_6H_6		C_6D_6	
Raman	Infra-red	Raman	Infra-red
607		583	
	669	666	(671)
849			817
993	1030	944	
	1483		1334
1176		867	
	(1620)		(1150)
1585, 1606		1552	
	(1780)		(1448)
3049		2265	
	(1950)		1610
3064		2292	
	3073		2246

[Combination tones are enclosed in parentheses. Fundamentals which correspond to the same proper vibrations in C_6H_6 and C_6D_6 are placed on a level. 'Coincidences' are marked ——.]

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Sept. 28.

[1] This will be discussed in a forthcoming publication by G. Placzek and E. Teller.

Diurnal Variation of Cosmic Ray Intensity and Nova Herculis

LAST year several articles were published describing measurements made with the intention of deciding whether the outburst of the Nova Herculis had an influence upon the intensity of cosmic radiation. The results obtained with the coincidence method are not in perfect agreement with each other: Kolhörster[1] has found, and we[2] have not found, a Nova effect. To clear up the question we made, from July 24 until August 5, 1935, measurements with two Geiger-Müller counters of 100 cm. effective length, and 4 cm. diameter, placed 7 cm. apart with their axes parallel to the north-south direction, one above the other. We used the Barnóthy coincidence method which makes it possible to neglect the number of chance coincidences, as they are less than 0·4 per cent of the true ones. The apparatus is provided with an automatic impulse size regulator which kept the sensibility of the counters during the whole time of measurements at a constant value, so that they were not influenced by any changes occurring in the inside temperature or in the supplying voltage. In 349 hours we registered 1·53 million coincidences; their distribution during the three periods of the day is shown in the accompanying table.

We infer from the foregoing that the intensity between 8^h and 16^h is with $1{\cdot}37 \pm 0{\cdot}17$ per cent more than during the other two periods. It may be of

interest to compare our results with those of Kolhörster[1] as the 'field' of our apparatus was similar to his. Kolhörster found for the same hours an intensity surplus of $1 \cdot 76 \pm 0 \cdot 28$ per cent, and interpreted it, with reservation, as an effect of the Nova Herculis. The two results, between the limit of error, can be said to be equal, notwithstanding the fact that

Interval (*M.E.T.*)	Intensity in coincidences per minute	Increase
8^h —16^h	$73 \cdot 78 \pm 0 \cdot 10$	$1 \cdot 37 \pm 0 \cdot 17$ per cent
16^h —24^h	$72 \cdot 78 \pm 0 \cdot 07$	
0^h — 8^h		

in our case, contrary to Kolhörster's, the Nova was not at that time in the 'field' of the apparatus. When the Nova, with an average magnitude of 7 in August, was in the 'field' of the apparatus, we found the intensity $1 \cdot 84 \pm 0 \cdot 13$ per cent less than the average during other hours of the day (Fig. 1).

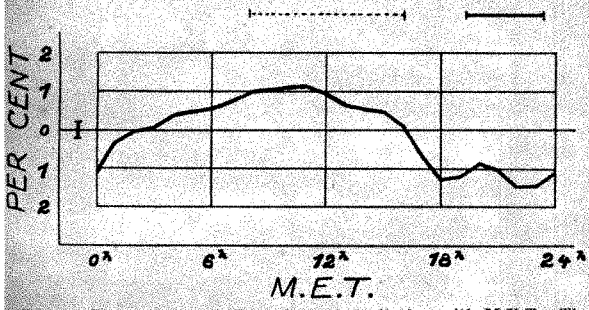

FIG. 1. Percentage variation of cosmic radiation with M.E.T. The points do not represent the original hourly values, but to smooth the curve the fourth means are plotted. Above the graph the time is marked when the Nova passed through the 'field' of our apparatus (July 1935, full line) and through Kolhörster's (Dec. 1934, dotted line).

It seems to be evident that the supposition expressed in an earlier paper[3] is justified, and that the intensity surplus observed by Kolhörster is really nothing else but the daily intensity variation of the cosmic radiation. The real cause of this daily variation, and the reason why it is larger with counter-tube methods than with ionisation chamber methods, cannot yet be satisfactorily explained. We believe, however, that it is not caused by the influence of the sun, but it may be the consequence of the daily variation of the earth's magnetic field intensity, perhaps diminished by the daily variation of the outer temperature. To support this opinion we may say that we have found a correlation coefficient of $-0 \cdot 73$ between hourly means of the cosmic ray intensity and horizontal intensity of the earth's magnetic field[4], and again a coefficient of $-0 \cdot 67$ between daily averages of cosmic ray intensity and outer temperature.

The experimental part of this work was kindly aided by the Hungarian Council for Natural Sciences.

J. BARNÓTHY.
M. FORRÓ.

Institute of Experimental Physics,
University,
Budapest.
Sept. 6.

[1] W. Kolhörster, *Z. Phys*, **93**, 429; 1935.
[2] J. Barnóthy and M. Forró, NATURE, **135**, 618; 1935.
[3] J. Barnóthy and M. Forró, *Z. Phys.*, **94**, 773; 1935.
[4] The magnetic data were taken from Landolt-Börnstein Erg. Bd. 3; they represent the mean values of the intensity for July and August in the period 1921–1930.

Positive and Negative Ions in the Primary Cosmic Radiation

THE observed east–west asymmetry of the cosmic radiation, and its increase with increasing altitude, has been interpreted in terms of an unbalanced primary radiation which is positively charged. It has been suggested by Compton and Bethe that the radiation probably consists of protons, the rest of the primary radiation consisting of equal numbers of positrons and electrons.

The existence of such an unbalanced positively charged radiation would mean that there would be a preponderance of ions of one sign in interstellar space, and, as has been pointed out by Swann[1], this would give rise to enormous differences of potentials between points separated by distances which are relatively small according to astronomical standards. That such differences of potential do not exist is guaranteed by the observed state of rest of the interstellar ionised calcium clouds as shown by Ross Gunn[2]. These considerations suggest strongly that equal numbers of positive and negative charges exist in the cosmic ray beam.

Swann[1] has shown further that any attempt to consider the emission of a greater number of ions of one sign than the other from stars or other heavenly bodies results in a condition in which the particles become bound to their respective stars as a sort of space charge.

Similarly, it would appear that if the earth had been bombarded, since its formation, by a primary cosmic radiation in which positively charged particles predominated, it would have gradually acquired a high positive potential. Finally it would, therefore, tend to repel those ions which were positively charged, while attracting those whose charges were negative. This would result in a gradual reduction of the earth's potential until equal numbers of positive and negative charges would be incident on the earth. It is apparent, therefore, that equal numbers of positive and negative ions must be falling on the earth at any instant, and it must be concluded that the azimuthal asymmetry must be explained in some different way other than in terms of an unbalanced positive component.

Ross Gunn has suggested that the positive and negative ions travel through space with equal velocities, and that the asymmetry is due to the differences between the penetrating power of the positive and negative ions, and to the different spirals, which, on account of their different rest masses, these particles describe in the earth's magnetic field.

H. J. WALKE.

Radiation Laboratory,
University of California,
Berkeley.
Sept. 5.

[1] Swann, *Phys. Rev.*, **44**, 124; 1933.
[2] Ross Gunn, *Phys. Rev.*, **45**, 900; 1934.

Slow Neutrons

FOR some months past we have been investigating the influence of the temperature of hydrogen containing material on the activity of silver irradiated by slow neutrons. In our experiments we have cooled down paraffin wax to the temperature of liquid air. Under these conditions, no increase of activity of silver has been observed. Moon and

Tillman[1] and also Fermi[2] have shown that the activity of silver increases to about 10–30 per cent when paraffin wax is cooled through the same range of temperatures as in our experiments. The only difference in the experimental conditions consisted in the fact that Tillman and Moon used a layer of cooled paraffin wax 1·7 cm. thick while in our experiments the thickness of this layer was about 10 cm. The discrepancy of the results may be explained by the assumption that the process of slowing down neutrons is accompanied by the absorption. In fact, if cooled paraffin wax absorbs slow neutrons more strongly than the paraffin at room temperature, then the decrease of the number of neutrons reaching the target in the case of a thick layer of cooled paraffin wax may counterbalance the increase of activity of neutrons.

We repeated our experiments under the former conditions and also measured the temperature effect using different thicknesses of paraffin cylinders containing the silver target. Neutrons before reaching these cylinders were strongly retarded. Experiments were made with three cylinders, 0·8 cm., 1 cm. and 1·7 cm. thick respectively. In all three cases, in cooled paraffin wax an increase of activity of silver was observed which diminished with the increase of thickness of paraffin. The increases amounted to 45, 24 and 13 per cent respectively. There was no increase of activity when the thickness of the paraffin layer was about 10 cm. The range of thicknesses investigated was greater than the mean free path of slow neutrons (0·5 cm.). At smaller thicknesses, a decrease of the influence of temperature should be again observed.

Our experiments prove the existence of the temperature effect and demonstrate the absorption of slow neutrons by paraffin. The absorption becomes stronger as the paraffin is cooled, that is, increases with the decrease of velocities of thermal neutrons.

The effective cross-section of neutrons calculated from our data, assuming the absorption by protons in paraffin wax, is about 10^{-24} cm. sq. The existence of the absorption of slow neutrons explains very well the fall of activity with great retarding thicknesses of water in the well-known experiments of Westcott and Bjerge[3]. The results of Lea's[4] experiments also may be explained in the same way, if under the conditions of his experiments the slow neutrons were present in sufficient number.

P. LUKIRSKY.
T. ZAREWA.

Physical Institute,
University,
Leningrad.
July 16.

[1] Moon and Tillman, NATURE, **135**, 904; 1935.
[2] Fermi, *La Ricerca Scientifica*, VI, 1, 11-12.
[3] Westcott and Bjerge, *Proc. Camb. Phil. Soc.*, **31**, 145; 1935.
[4] Lea, NATURE, **133**, 24; 1934.

Suggested Improvements of Morse's Rule

MORSE's empirical relation[1] between r_e and ω_e for di-atoms has recently formed the subject of considerable discussion. It has been amended by three authors, (*A*) Allen and Longair[2], who introduce the 'reduced mass' μ, (*B*) Badger[3], who utilises the bond-constant k_0 derived from a pendulum-type formula, and (*C*) one of us (C. H. D. C.)[4], who uses the group number n. It is noteworthy that each of these modifications introduces period constants, varying discontinuously between different molecular periods. The amendments assume interest in view of the preliminary theoretical attack on the problem from the point of view of wave-mechanics by Newing[5], whose general conclusion is: "We shall expect a law of the type that has been suggested by Badger and by Clark". Further analysis is promised.

The modifications may be tested in their capacity to reproduce experimental values of r_e (in Å.) from known ω_e (in cm.$^{-1}$). The following average ($\pm$ per cent) errors are found for 31 electronic levels of di-atoms of the *KK* period: (*A*) 2·7, (*B*) 1·7, (*C*) 1·2, as against the unmodified formula: 5·3. The *C* formula ($\omega_e r_e^3 \sqrt{n} = 9{\cdot}70 \times 10^{-21}$ cm.^{2}) is therefore the best for this period.

Allen and Longair[2] have stated that the *C* formula will be inapplicable to isotopic molecules, where the r_e's may be closely alike whilst the ω_e's are different. The only case cited in the *KK* period is of $B^{10}O$ and $B^{11}O$, where in the ground states the *C* formula gives errors of $-1{\cdot}1$ and $-0{\cdot}2$ per cent, respectively. Since both these numbers are within the average error ($\pm 1{\cdot}2$ per cent), it would appear that in practice the objection of Allen and Longair has no very serious weight.

Further details of the above and kindred calculations will be published elsewhere.

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J. L. STOVES.

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Oct. 9.

[1] P. M. Morse, *Phys. Rev.*, (ii) **34**, 57; 1929.
[2] H. S. Allen and A. L. Longair, *Phil. Mag.*, (vii) **19**, 1032; 1935.
[3] R. M. Badger, *J. Chem. Phys.*, **2**, 128; 1934; *Phys. Rev.*, (ii) **48**, 284; 1935.
[4] C. H. Douglas Clark, *Phil. Mag.*, (vii) **18**, 459; 1934. NATURE, **133**, 873; 1934.
[5] R. A. Newing, *Phil. Mag.*, (vii) **19**, 759; 1935.

Viscosity of Air and the Electronic Charge

THE greatest uncertainty in determining the electronic charge e by the oil drop method of Millikan is introduced by the uncertainty in the assumed value of the coefficient of viscosity of air, η. The value adopted by Millikan in 1917

$$\eta_{23^\circ} = (1822{\cdot}6 \pm 1{\cdot}2) \times 10^{-7}$$

is probably too low, and its accuracy overestimated, as is pointed out by Shiba[1].

Considering the fundamental importance of the constant e, I have undertaken a new determination of η, using the rotating cylinder method also employed by Millikan and his co-workers[2,3]: An inner cylinder of electron metal, suspended vertically by a fine phosphor-bronze wire between two guard cylinders of equal diameter is deviated from its equilibrium position through an angle φ by a concentric outer cylinder, rotating with constant velocity, η being calculated from the equation

$$\eta = \frac{I\,(b^2 - a^2).\varphi\, t}{2\, a^2 b^2\, l\, T^2}, \quad \text{where}$$

a = the radius of the inner cylinder = 2·81767 cm. at 20°;
b = the radius of the outer cylinder = 3·26628 cm. at 20° or = 3·18328 cm. at 20° (two different cylinders);
l = the length of the inner cylinder = 9·9981 cm. at 20°;
t = the time of revolution of the outer cylinder (20 – 150 sec.);
T = the period of oscillation of the suspended system (53 – 128 sec., using different suspensions);

I = the moment of inertia of the suspended system about the line of suspension = 423·22 gm.cm².

The mean value of 51 determinations of η for dry air at temperatures between 18·9° and 20·9° is

$\eta_{20°} = (1820{\cdot}0 \pm 3{\cdot}0) \times 10^{-7}$ corresponding to
$\eta_{23°} = (1834{\cdot}8 \pm 3{\cdot}0) \times 10^{-7}$.

From this we get

$$e = \left(\frac{1834{\cdot}8}{1822{\cdot}6}\right)^{3/2} \times 4{\cdot}770 \times 10^{-10} = (4{\cdot}818 \pm 0{\cdot}012) \times 10^{-10} \text{ E.S.U.},$$

the uncertainty stated being due only to the viscosity, other sources of error not being considered here.

I am, therefore, of the opinion that the discrepancy between the 'oil drop value' of e and the 'X-ray value' can be explained by the error in η.

A more detailed report will be published elsewhere.

GUNNAR KELLSTRÖM.

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Sept. 11.

[1] K. Shiba, *Scient. Pap. Inst. Phys. Chem. Res., Tokyo*, **19**, 97; 1932. **21**, 128; 1933.
[2] L. Gilchrist, *Phys. Rev.*, **1**, 124; 1913.
[3] E. L. Harrington, *Phys. Rev.*, **8**, 738; 1916.

Nature of Atmospherics

A SYSTEMATIC study of atmospherics was recently commenced in this laboratory (lat. 11° 25′ N., long. 79° 44′ E.), in view of the importance of the problem in connexion with broadcasting in the tropics. A tuned receiver and a galvanometer of period 1 second were used to record photographically the atmospherics. The results obtained during the months of October and November 1934 (a period during which the atmospheric activity was extremely severe) are of much interest, in connexion with the discrepancies observed between the results for the average duration of atmospherics as recorded by several investigators.

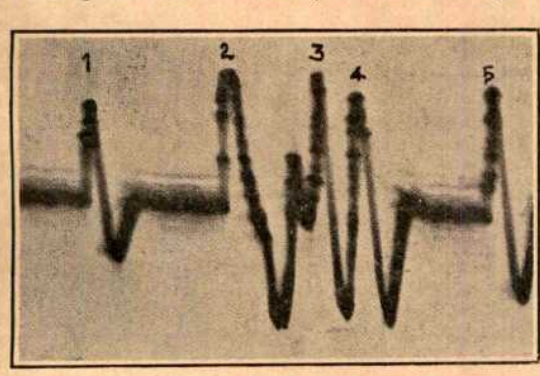

FIG. 1.

In the accompanying illustration (Fig. 1), which is an enlargement of a section of one of the records, certain thickenings are observed along the trace of the galvanometer motion. The number of thickenings or dots, which indicate the number of separate impulses received by the galvanometer in any given interval, can be arranged into groups taking into consideration the rate at which they succeed each other. The curves show that the number of components in groups 1–5 are 4, 12, 8, 10 and 6 respectively. The total duration of each 'atmospheric' is about ½ second. The number of components as indicated by the dots range from 4 to 12. These separate impulses may be due to the separate strokes ranging in number from 1 to 12, constituting a lightning discharge, observed by Schonland and Collens[1].

These individual strokes themselves may be composite, but their nature cannot be recorded or indicated by instruments of periods 0·1–1 sec. The peaks in the records of Munro and Webster[2] may be taken to correspond to the thickenings or the dots in the curves reproduced here.

The dots indicate what may be called the *gross structure* of the atmospheric. In addition to this, there is also evidence of a *fine structure* as revealed by the cathode ray oscillograph records of Watt and Appleton[3]. The durations as observed by them are of the order of milli-seconds, and in many cases the main structure of the atmospheric was supplemented by ripples superposed on the growth and decay slopes. The variations observed during these small intervals may be referred to as the *fine structure* of the components of an atmospheric and are probably due to lightning discharges succeeding each other at intervals of the order of milli-seconds.

The records reproduced here throw light on the discrepancies between the observations of lightning flashes reported by Schonland and Collens, Boys[4] and Halliday[5] on one hand, and Munro and Webster[2] on the other. The former authors record about 10–12 component flashes, whereas the latter have observed up to fifty. Although this difference may be explained according to Munro and Webster[2] on the supposition that a multitude of small flashes occur within the cloud and hence could not be recorded by the camera, there is another explanation which is in agreement with all the observations.

Taking into account the results outlined above, the close agreement between the number of components of an atmospheric as recorded by instruments of relatively long periods (0·1–1 sec.) and the number of lightning flashes recorded by moving lens cameras, and also the complex nature of these components revealed by the work of Watt and Appleton[3], it appears reasonable to suppose that the fifty flashes observed by Munro and Webster are not in the same temporal relation with one another. These can be divided into 10 or 12 groups, each group being separated from the previous one by periods of the order of 0·1 second. Each group may consist of 4 or 5 flashes (occurring either inside the cloud or outside visibly) succeeding each other at intervals of the order of milli-seconds and giving rise to what has been described as the fine structure.

This view is supported by the recent work of Appleton and Chapman[6] on lightning flashes, and is in agreement with the facts revealed by the cathode ray oscillograph and by instruments of much larger periods and with all the observations on lightning flashes recorded so far, as well as with the audible effects produced in a wireless receiver.

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Annamalainagar,
South India.
Sept. 4.

[1] *Proc. Roy. Soc.*, A, **143**, 654; 1933.
[2] NATURE, **134**, 880; 1934.
[3] *Proc. Roy. Soc.*, A, **103**, 84–102; 1923.
[4] NATURE, **131**, 765; 1933.
[5] *Phil. Mag.*, **15**, 409; 1933.
[6] NATURE, **134**, 968; 1934.

Influence of Substituents on Organic Reactions: a Quantitative Relationship

FLÜRSCHEIM[1] made the classical observation that substituent atoms or groups influence the dissociation of carboxylic acids and amines in a manner related to their effect on further substitution in benzene derivatives containing them. This has led, directly or indirectly, to much further work which has established that this type of qualitative relationship applies to the velocities of a wide variety of reactions and to a number of dissociations. The results have been extensively discussed either in terms of Flürscheim's Theory of Valency or in terms of the electronic theory which has incorporated the essential elements of the earlier conception. But these discussions have been concerned with sequences of groups or other qualitative considerations.

In more limited fields such relationships have been found to be quantitative. For example, H. B. Watson and his collaborators[2] have found quantitative relationships between the dipole moments of substituents and their influence from the *m*-position on the velocities of side-chain reactions and also on dissociations. Hammett and Pfluger[3] found a linear relationship between the logarithms of the velocity constants for the reaction of a series of methyl esters with trimethylamine ($R.CO.O.Me + NMe_3 \rightarrow R.COO' + NMe_4^+$) on one hand and the logarithms of the dissociation constants of the corresponding carboxylic acids on the other*.

It now appears that this last quantitative relationship is more general. Plotting the logarithms of the dissociation constants of a number of *m*- or *p*-substituted benzoic acids as a reference series and, against them, the logarithms of the velocity constants of a number of side-chain reactions involving substances containing the same *m*- or *p*-substituents, one obtains a series of linear relationships. For example, a straight line is obtained for the alkaline hydrolysis of the various substituted ethyl benzoates, another for the substituted benzamides and others for the solvent hydrolysis of the benzyl chlorides, the acid catalysed hydrolysis of the potassium arylsulphates, the alkaline hydrolysis of the ethyl cinnamates and so on. The logarithms of dissociation constants other than those of the substituted benzoic acids (for example, those of the phenylacetic acids) can be similarly related to the same reference series. The choice of this is quite arbitrary and the relationships of course hold between the different phenomena as well as between them and the reference series. The significance of individual deviations from the straight lines constitutes a separate problem but the deviations do not vitiate the generalisation. This has been applied here to *m*- and *p*-substituted derivatives only, but this does not represent the limit of its applicability although the curves for other types of compound will not generally be co-linear with those for the *m*-*p*-series. Reactions which have required special consideration in terms of electronic theory will, in general, show more complex relationships to those of the linear group.

The applicability and significance of these relationships are discussed in a more detailed communication which is being submitted for publication, but a few general points may be noted here.

The slopes of the curves measure the relative sensitivities of the different phenomena to variations of structure of the type considered, but in interpreting this in detail the slight variation of slope with temperature must be allowed for.

According to the transition state method as used by Evans and Polanyi[4], the velocity constant of a reaction is determined by the equilibrium between the initial and transition states. Log k (velocity) is directly related to the free energy change in this process as log K (equilibrium) is to the total free energy change in dissociation, and the linear relationships described above may be stated as follows in terms of the transition state conception:

The influence of substituents on the free energy change associated with the equilibrium between the initial and transition states, in a reaction considered in respect of velocity, is directly proportional to their influence on the free energy change between the initial and final states in a corresponding acid dissociation.

The interpretation of this in terms of the Arrhenius Equation seems to require a parallelism between the variations in the α and in the E terms.

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Sept. 29.

* Since this letter was passed for press, a further paper by Hammett (*Chem. Rev.*, **17**, 125; 1935) has been received, which extends greatly the application of the linear relationship to the reactions of pairs of closely related substances.

[1] *J. Chem. Soc.*, **95**, 725; 1909.
[2] *J. Chem. Soc.*, 893; 1933. *Chemistry and Industry*, **54**, 735; 1935.
[3] *J. Amer. Chem. Soc.*, **55**, 4079; 1933.
[4] *Trans. Faraday Soc.*, **21**, 875; 1935. Compare also Wynne-Jones and Eyring, *J. Chem. Phys.*, **3**, 492; 1935.

Spectrum Analysis

IN response to Mr. Twyman's appeal[1], may I express the hope that the term "spectrum analysis" will continue to be used "to denote the analysis of substances by means of their spectra"? The term is a technical one with an established meaning which a student has to learn, and it would introduce a very bad principle to change such terms whenever opportunities arise for them to be misunderstood by those who have not taken the trouble to find out what they mean. We might, for example, be asked to abandon the term 'solar time', because a post-relativity physicist takes it to be the time kept by an observer on the sun; or to give up speaking of 'stellar magnitudes' now that we have learnt to measure stellar volumes.

There are strong historical reasons for confining 'spectrum analysis' to its original meaning. It formerly included every spectroscopic operation, and when other than analytical applications of the instrument became predominant, the more general term 'spectroscopy' was introduced (I think by Schuster), 'spectrum analysis' remaining as a particular and decreasingly important part of the wider subject. In recent years—thanks partly to the better understanding of spectra and their variations which has come from physical theory—there has been, as Mr. Twyman well knows, a remarkable revival of spectrum analysis, while the term-analysis of spectra, on the other hand, has proceeded so far as to be well on the decline. It would therefore not only be inappropriate to rob a rejuvenated subject of its name in favour of a declining one, but it would tend also to hinder reference by modern workers to such ancient classics on spectrum analysis as those of Lockyer, Roscoe, Schellen and others, which record practical experience now largely forgotten and well worth attention by practitioners of a revived art.

I am loth even in appearance to temper these remarks by discussing Mr. Twyman's suggested alternatives, but since he intends temporarily to adopt one of them, I am tempted to do so. Spectroscopic (or spectrographic, which, as Prof. Curtis would probably agree, better describes modern practice) analysis seems preferable to spectrochemical analysis for the following reason. There are three experimental 'hall-marks' of an atom—atomic weight(s), spectrum, chemical properties—and, correspondingly, three methods of analysis, which might be called 'mass-analysis' (by Dr. Aston's instrument, for example), 'spectrographic analysis' and 'chemical analysis'. 'Spectro-chemical analysis' would then indicate an analysis jointly by spectrographic and chemical methods—a not uncommon process, I believe, as in cases where the qualitative analysis is spectrographic, and the quantitative, chemical. It would be a pity to give the name 'spectro-chemical analysis' to a process in which chemical methods are not used.

I repeat my opinion, however, that the proper course to take would be to call spectrum analysis by its own name, and let the penalties of misunderstanding fall on those who are ignorant of physical nomenclature rather than on those who conscientiously learn it.

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Oct. 16.

[1] NATURE, 136, 609, Oct. 12, 1935.

Antagonistic Effect of Potassium Iodide in Baldness due to Thallium Acetate

THALLIUM salts administered per os or subcutaneously in the body disturb the equilibrium of mineral metabolism[1], bring about lesions in the central and peripheral nervous system[2], cause disturbances in the endocrine system[3], have a deleterious effect upon the heart[4], bring about disturbances in the digestive tract[5] and kidneys[6] and have unfavourable effects upon development and growth of animals[7]. Further, the daily administration of thallium for a longer period of time brings about in animals, especially in young ones, under-development of skin[8], atrophy of hair follicles, hyperplasy and hypertrophy of sebaceous glands[9], degenerative changes of hair[10], and alopecy[11].

In our experiments we used six groups of rats. The first three groups received daily, per os, 3, 4 and 6 mgm. of thallium acetate per 1,000 gm. weight, respectively. The other three groups received the same quantity of thallium acetate per os, and in addition, each animal received daily, subcutaneously, 0·75 c.c. of a two per cent solution of potassium iodide. After 12–16 days, the rats which received only thallium acetate started losing their hair and at the end of the experiment (35 days) all the surviving animals had lost most of their hair, and some of them, especially those which were getting higher doses, became entirely bald. On the other hand, the rats which received thallium acetate per os and potassium iodide subcutaneously retained completely their hair coating. Also, the mortality in the groups with potassium iodide was smaller, which indicates that potassium iodide reduces the toxicity of thallium acetate.

The object of further experiments being carried out by us is to determine whether other salts of iodine, such as sodium iodide, lithium iodide, calcium iodide and magnesium iodide, prevent partly or entirely the loss of hair caused by thallium and reduce the deleterious action of thallium upon organisms.

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[1] Klopstock, *Med. Klin.*, 345; 1924.
[2] Dixon, *Proc. Roy. Soc. Med.*, 20, 79; 1927.
[3] Buschke und Peiser, *Med. Klin.*, 18, 23; 1922.
[4] Buschke und Jacobsohn, *Dtsch. med. Wschr.*, 859; 1922.
[5] Seitz, *Klin. Wschr.*, 1, 157; 1930.
[6] Schneider, Ref. *Zbl. Hautkrkh.*, 35, 124.
[7] Buschke und Peiser, *Klin. Wschr.*, 1, 44, 2182; 1922.
[8] Bernhardt, Ref. *Zbl. Hautkrkh.*, 14, 42.
[9] Mamoli, Ref. *Zbl. Hautkrkh.*, 18, 39.
[10] Leigheb, Ref. *Zbl. Hautkrkh.*, 29, 523.
[11] Fiocco, Ref. *Zbl. Hautkrkh.*, 18, 790.

A 'Dope' for Embedding Wax

ATTENTION has been directed by Higgs[1] to the effect of small quantities of petroleum ceresins in causing paraffin wax to cool in a microcrystalline state. It seemed possible that this effect might be valuable in the technique of cutting paraffin sections. During this summer we have been using, for the routine sectioning of early amphibian embryos, a paraffin wax mixture, without addition of beeswax but containing 0·5 per cent of petroleum ceresin which was supplied by Messrs. Shell-Mex and B. P., Ltd. The results have been all that could be desired, the wax cooling with a very fine texture even when the embedding dish was allowed to cool in the air without being immersed in water. It is necessary to use a mixture having a melting point, before the addition of ceresin, slightly lower than is normally appropriate. The electrostatic properties of the wax appear to be unaltered. The 'dope' may be particularly useful in embedding large objects, in which ordinary wax tends to cool too slowly in the centre of the block.

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[1] Higgs, P. G., *J. Inst. Petroleum Tech.*, 21, 1; 1935. See also NATURE, 135, 113; 1935.

Corophium curvispinum, G. O. Sars, var. *devium*, Wundsch, in England

WHILE passing through Tewkesbury on June 30, 1935 I found thirteen specimens of *Corophium curvispinum* var. *devium*, inhabiting tubes made upon submerged plants in shallow water near the left bank of the River Avon about two hundred yards below King John's Bridge. From the associated flora and fauna I believe this water to be permanently fresh, though I took no measurements of salinity. Prof. Wundsch has kindly confirmed my identification.

The species *C. curvispinum* was described and figured by Sars[1] from the Caspian Sea in 1895. In 1912, Wundsch[2] described *C. devium* as a new species from fresh water in the Muggelsee, near Berlin. Later

Behning[3], having seen specimens from other localities, reduced *C. devium* to a freshwater variety of *C. curvispinum*, an alteration to which Wundsch[4] agreed. In both these papers Wundsch gives figures adequate for identification.

Wundsch[5] gave a map of the known distribution of the variety in 1919, and Wolski[6] in 1930 gave a list of localities without adding much to the range known in 1919. It inhabits the lower and middle courses of rivers running into the Caspian Sea (Volga and its tributaries), the Black Sea (Danube, Dnieper and Don) and North Sea and Baltic (Niemen to Elbe): also two lakes in the Caucasus near the Caspian Sea. It has not yet been found west of the Elbe.

Wundsch[4] stated that in 1915 this variety was spreading rapidly in Germany, moving through canals and rivers from east to west and usually downstream.

It is unlikely to have been introduced from its European localities with living fish, since no example of such importation of stock to the Severn or Avon is known to the secretaries of the Bristol Naturalists, the Fishmongers Company or the Severn Fishery Board. But ships from the Baltic and the Black Sea reach Bristol Docks, and might carry specimens in the fouling on the hull. Nothing is known of the resistance of this variety to sea-water travel.

It would be of interest to ascertain the present distribution of this variety in England, and in Europe west of the Elbe. It might thus be made clear how it reached Tewkesbury, and how rapidly it is able to spread in our rivers.

Its usual localities are the lowland fresh-water reaches of sluggish rivers. It lives in tubes made of mud upon weed or piles. Specimens of *Corophium* found burrowing in mud are almost certain to be the common species *C. volutator*.

I shall be pleased to identify any specimens of *Corophium* sent me. The general aspect of species of this genus is clearly shown in the drawings of Sars[7].

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[1] G. O. Sars, *Bull. Acad. Sci. St. Pétersb.*, Ser. 5, 3, 302; 1895.
[2] H. H. Wundsch, *Zool. Anz.*, 39, 729; 1912.
[3] A. Behning, *Zool. Jb.*, 37, 385; 1914.
[4] H. H. Wundsch, *S. B. Ges. Naturf. Fr. Berl.*, Nr. 3, 56; 1915.
[5] H. H. Wundsch, *Arch. Hydrobiol. Plankt.*, 12, 698; 1919.
[6] T. Wolski, *Frag. faun. Mus. Zool. polon.*, 1, 152; 1930.
[7] G. O. Sars, "Crust. Norway", 1. Amphipoda, 1894.

Points from Foregoing Letters

A MODEL consisting of a football bladder and rubber blocks, to illustrate how early forms of sea-urchins (of Cambrian age) may have behaved under tidal conditions, has been constructed by Dr. W. K. Spencer. The model opens and closes automatically under the influence of changes in hydrostatic pressure, acting upon the elastic body-wall.

To elucidate the 'shape' of the benzene molecule, the principal lines of the infra-red spectrum of benzene containing heavy hydrogen, C_6D_6, are compared with those of ordinary benzene, C_6H_6, by a group of investigators from University College, London. The authors conclude that, as in the case of the Raman spectra, the apparently coincident frequencies are accidental, and consequently there is no longer any reason for physicists to reject the regular hexagon model accepted by chemists for the benzene molecule.

An increase in the intensity of cosmic rays was observed by Kolhorster during the outburst of Nova Herculis, between 8 h. and 16 h., when that star was in the 'field' of his apparatus, and he therefore suggested that cosmic rays originate in novæ. Drs. J. Barnóthy and M. Forró now find an increase in the intensity of cosmic rays between 8 h. and 16 h. as a normal diurnal variation, which they tentatively ascribe to changes in the earth's magnetic field and in the outer temperature.

It has been suggested that there are more positive than negative particles in cosmic 'rays'. H. J. Walke enumerates several objections to this view. He prefers Ross Gunn's explanation of the east-west asymmetry of the cosmic rays, namely, that it is due to differences in the penetrating power of positive and negative particles and in the spiral paths which they describe under the influence of the earth's magnetic field.

Moon and Tillman have found that the radioactivity induced in silver by neutrons slowed down by passage through a thin layer of paraffin wax is increased when the wax is cooled by liquid air. Prof. P. Lukirsky and T. Zarewa, using a thicker layer of paraffin, failed to observe this temperature effect; but now, using thinner layers, they confirm it. With thicker layers, the increase in the activity of the neutrons, caused by lowering the temperature, is apparently counterbalanced by loss due to absorption.

C. H. Douglas Clark and J. L. Stoves claim that the modification to Morse's relation between the equilibrium internuclear distance r_e and the vibration frequency ω_e of 'di-atoms', suggested by one of them (C. H. D. C.), gives better approximations to the actual experimental values than either Allen and Longair or Badger's suggestions.

The charge of an electron calculated from X-ray wave-lengths determinations comes to $4{\cdot}80 \times 10^{-10}$ E.S.U., whilst the usually accepted value obtained from the rate of fall of electrified droplets is $4{\cdot}77 \times 10^{-10}$ E.S.U. Dr. Gunnar Kellstrom has re-determined the viscosity of dry air and finds a value different from that used by Millikan when he calculated the electronic charge by the falling droplets method. The recalculated electronic charge agrees with that deduced from X-ray wave-length determinations.

Records of atmospherics obtained with a galvanometer (of period 1 second) by N. S. Subba Rao indicate that lightning flashes have, in addition to the 'fine' structure revealed by the cathode ray oscillograph, also a 'gross' structure, due to the fact that the flashes occur in groups of 4–12. The duration of such a group is about $\frac{1}{2}$ sec. Each member of the group may be due to 1–12 separate strokes as observed by Schonland and Collens, and these strokes may themselves be composite. This complex nature of the electric discharge may account for the divergence in the observations of lightning flashes reported by various investigators.

Experiments upon rats, carried out by O. V. Hykeš and F. A. Diakov, indicate that potassium iodide reduces the toxicity of thallium acetate, and in particular prevents the loss of hair caused by thallium poisoning.

Research Items

Flint-mining at Grime's Graves, Norfolk

SINCE 1921 Mr. A. Leslie Armstrong has been engaged in exploring Grime's Graves, the famous East Anglian prehistoric flint mining site. A report on the results of the excavations, which are still in progress, was presented by Mr. Armstrong to Section H (Anthropology) at the Norwich meeting of the British Association on September 6. A gradual evolution in mining methods, in the tools used, and in the form of the mine shafts has now been demonstrated. Three well-defined phases are recognisable: (1) The primitive phase, in which the shafts are devoid of galleries, and picks made from the long bones of animals are used exclusively; (2) the intermediate phase, in which the shafts are in the form of open workings, but are devoid of galleries, and deer antler picks appear for the first time, increasing until they exceed the earlier bone form in number; (3) the late phase, of deep shafts with mined galleries, in which celts with pointed butts appear and the picks are of deer antler. Trenching and trial excavation have defined the area in which mining was carried on and have also revealed the circumstances which caused the mining to be confined within these limits. There is evidence of occupation in bronze-iron age times, but all mining had ceased before this date.

Wild Cat in Scotland

A SUMMARY of the position of the Scottish wild cat at the present time has recently been given by G. Dent (*J. Soc. Pres. Fauna of the Empire*, N.S., Pt. 26, **48**, Sept. 1935). In the years just before the War, the species was confined to a limited area in the counties of Ross and Sutherland. The author thinks it unlikely that any survived to the south of Loch Ness. The advent of the War gave the wild cat a chance of multiplying and spreading. By 1919 it had crossed Loch Ness and become well-established in Inverness-shire and parts of Perthshire; individuals were trapped on estates where none had been seen for fifty years or more. They have penetrated into parts of Stirlingshire; and have reached so far south as Callander, Gleneagles and Loch Lomond-side; westwards they have appeared in eastern Argyllshire. The author is of opinion that the wild cat will maintain its hold in many parts of the newly-won territory.

South African Fishes

AMONG many interesting papers published in the *Records of the Albany Museum* (**4**, Part 2, 1935), Mr. J. L. B. Smith describes some new and little-known fishes from South Africa. A large number of specimens of *Myliobatis cervus* n.sp., 'Pyl-Stert' (Krysna) were obtained. This species is very like *M. aquila*, and the females can only be distinguished by the shape of the snout. The female of *M. cervus* appears to seek the shallow banks of the river, where the young are born. One large specimen after capture gave birth to seven young. These 'rays' are evidently preyed upon by various species of 'sharks'. On one occasion a large *aquila* was observed to take refuge in a few inches of water on the edge of a bank in the river, violently beating the water with its pectorals in order to scare off a large 'shark' which lay close in, with part of its body out of the water. The *aquila* was secured, an adult female, and three young were born after capture. On another occasion, a large female *aquila* was caught on a line and, being too large for the boat, was tied to the bows. Several young were born, and drifted down with the tide, one being swallowed by a large 'shark'. In the summer months at Krysna a cold current, of temperature 50° F., frequently sets inshore, numbing innumerable fish. It is shown that an *Iso natalensis* (Atherinidæ) does not seem to be inconvenienced by this cold water, and the presence of *Chaetodon marleyi*, a species of a genus usually found farther north, in the river, is a sure sign that the onset is imminent; when the cold water actually enters the river dead specimens are usually thrown ashore.

Digestive Tract of *Emyda vittata*

A. NARAYANA RAO (*J. Mysore Univ.*, **7**, 1933–34) describes the digestive tract of the mud-turtle, *Emyda vittata*, which lives near the water-margins of the tanks and burrows in soft earth. The œsophagus is differentiated into two regions, an anterior lined with stratified epithelium and with few mucous cells, and a posterior with numerous mucous cells. In the stomach are two kinds of glands—tubular glands lined by cubical cells and mucous glands, but there are no oxyntic cells. There is no pyloric sphincter between the stomach and intestine. The pre-rectal region of the intestine possesses a longitudinal typhlosole which reduces the cavity of the intestine to a semilunar slit. The author states that the turtle feeds on animal dung and other matter poor in nutriment, and the typhlosole presents a larger surface for absorption and also retards the rate of passage of the food. He directs attention to the appearance of the typhlosole in this turtle as an archaic character. Spaces lined by cells, and with a rich supply of blood-capillaries, occur between the circular and longitudinal layers of muscle in the wall of the rectum. "The animals when kept under water are seen to take in large quantities of water and the presence of blood vessels in the vicinity of these spaces . . . points to the existence of intestinal respiration."

Maturity of Fruit

THE term 'maturity' as applied to fruit denotes, for practical purposes, a condition where maximum value as an article of human food has been attained. Physical and chemical changes which accompany the process of maturation have been studied by Dr. J. C. Hinton, of Long Ashton Research Station, Bristol, who publishes a series of three papers on this subject in the Station's annual report for 1934 (pp. 29–108). The first paper, which is really the fourth of an extensive series, traces the changes in catalase and oxidase content. It shows that the former increases for a time, whilst the latter decreases steadily during storage. An ingenious hardness tester has been used to obtain the results reported in the second paper. Apples soften steadily during storage; but the rate depends upon the time of picking. The rate of loss in weight during storage is

also correlated with time of picking, and it is further suggested that apples growing in grass-covered orchards, or on trees which have been bark-ringed, or where fruit thinning has been prosecuted, ripen slower than in orchards with clean cultivation. Changes in nitrogen, acid-hydrolysable material, total sugars, and sucrose in relation to reducing sugars, are discussed in the third paper.

A Disease of Young Walnut Trees

DR. JOYCE B. HAMOND, of the East Malling Research Station, Kent, has published the results of her work on "The Morphology, Physiology and Mode of Parasitism of a species of *Chalaropsis* infecting Nursery Walnut Trees" (*J. Pom. and Hort. Sci.*, **18**, 81, June 1935). Walnuts are propagated at East Malling by grafting scions upon seedlings of *Juglans nigra*. The method is usually successful, but in the spring of 1930, a large number of grafts failed, as a result of attack by a fungus. This parasite is now known to be *Chalaropsis thielavioides*. It produces macrospores and endospores, appears under four strains on different hosts, attacks lupins and causes a rot upon carrots. Infected grafts show discoloration of the scion, with a mass of black, sooty spores along the plane of union. Weak solutions of formalin are used to paint the cut made upon the stock during grafting, and to spray the walls and shelves of the propagating house. These precautions control the disease effectively in practice.

Origin of Potash-Rich Rocks

RUTH DOGGETT TERZAGHI has recently discussed the origin of 'orthoclase-rich rocks', which term she applies to those of which the composition lies in the orthoclase field of the felspar equilibrium diagram (*Amer. J. Sci.*, April 1935). Reference is made to Vogt's suggestion that when water is present in relatively large quantities in the liquid phase, potash and plagioclase felspar may be in equilibrium with a liquid having a higher ratio of Or to $(Ab+An)$ than if the melt is 'dry'. It is also shown that high pressure may be expected to displace equilibrium in the same sense. More important, however, is the recognition that some of the potash-rich rocks which appear to be of igneous origin may have been produced by metasomatic processes, such as the felspathisation of quartzite. It is also pointed out that, during hydrothermal alteration and weathering of igneous rocks, the potash/soda ratio may undergo a considerable increase which is not always accompanied by easily diagnosed changes in the appearance of the rock. Attention has been more recently directed to relevant work by Fenner on the action of hot waters on the Yellowstone lavas (*Amer. J. Sci.*, Aug. 1935). In this investigation, Fenner conclusively proved that obsidian is greatly enriched in potash by a process of adularisation accompanied by devitrification of the ground-mass (*Trans. Amer. Geophys. Union*, Fifteenth Annual Meeting, 1934, pp. 241–243).

Light of the Night Sky

LORD RAYLEIGH and H. Spencer Jones have analysed measurements made on the light of the night sky at Terling in Essex, Canberra and the Cape over a period of more than eight years (*Proc. Roy. Soc.*, A, **151**, 22, August, 1935). The measurements were made in spectral regions in the blue, in the red, and around the green auroral line. Periodic yearly and half-yearly variations were detected at all the stations, the former apparently depending on latitude in a complicated way. The auroral component shows a long-period variation common to the three stations and clearly connected with the sunspot cycle, while the slow variation in the blue and red regions is much less clearly defined. There is rather feeble evidence of a connexion between the irregular variation of the auroral green light and magnetic disturbance. The absolute intensities of the light at the three stations are comparable, but seem to be higher at Terling and lowest at the Cape.

A New Discharge Tube Vapour Lamp

AT the opening meeting of the Illuminating Engineering Society, on October 8, a novel 'super high pressure' mercury vapour lamp was shown. It was developed in the physics laboratories attached to the Philips' factories, the aim in view being to increase the light-giving power of ordinary h.p. mercury vapour lamps. It consists of a quartz tube with thick walls having an internal diameter of $\frac{3}{64}$ in. and an external diameter of $\frac{1}{4}$ in. The electrode at each end of the tube consists of a simple tungsten wire sealed into the quartz; an interposed layer of a special grade of glass being necessary as the coefficients of thermal expansion for tungsten and quartz are so different that they prevent hermetical sealing. To facilitate the emission of electrons, the electrode tips are coated with a deposit of alkaline earth oxides and project from a small drop of mercury which condenses at each end. The lamp is placed inside a jacket containing running water. It needs no special stabilising apparatus as it is fed through an auto-transformer. The spectrum of the light produced is continuous, but the mercury lines stand out and are broadened. The luminous efficiency is about 50 lumens (4 candles) per watt. One of the most important advantages of the lamp is that the luminous part is less than $\frac{3}{64}$ in. and so the brightness is very high—about one quarter of the brightness of the sun. This makes it valuable when a concentrated beam is necessary as, for example, in cinema projectors, lighthouses and in all kinds of projectors. The source is almost a point and absorbs 1,500 watts per inch length of discharge. As a source of ultraviolet light, it seems likely to be of use in medical applications, and the absence of thermal inertia is of great value in cinematograph projection.

Chemistry of Antiquities

J. R. PARTINGTON (*Chemistry and Industry*, **54**, 884; 1935) has summarised the results of chemical interest arising from the recent excavations in the Bucheum, near Armant, carried out by direction of Sir Robert Mond and published as the forty-first memoir of the Egypt Exploration Society by Mond and Oliver H. Myers. The article deals with the process of mummification which was probably used for the sacred bulls, with a description of two curious instruments employed in the process. It also gives a table of analyses of metal objects found on the site, some of the bronzes containing large amounts of lead. Some additional information on textiles is also given. The remains probably date from about 357 B.C. to about A.D. 295, and the results are particularly interesting to the historian of chemistry, since it was in this period that the beginnings of chemistry are supposed to have had their origin in Egypt. The article directs attention to this aspect.

Man and the Universe*

THE WIDER PROBLEMS OF ASTRONOMY

WHEN the theory of relativity was enlarged so as to cover the facts of astronomy, it became necessary to discard the symmetry between space and time which had hitherto prevailed. Thus time regained a real objective existence, although only on the astronomical scale, and with reference to astronomical phenomena. De Sitter attacked the problem from the other end, and reached the same conclusion. He began by postulating symmetry between space and time, and found that for such symmetry to prevail, the universe must be totally devoid of matter. As the actual universe certainly contains matter, it is clear that de Sitter's postulate must be discarded. In other words, space and time must be intrinsically different in their natures—which is of course precisely what the plain man has believed throughout. This gives us every justification for reverting to our old intuitional belief that past, present and future have real objective meaning, and are not mere hallucinations of our individual minds—in brief, we are free to believe that time is real.

In 1926 de Broglie and Schrödinger introduced the new quantum mechanics. The universe was no longer regarded as a collection of particles, but as a collection of waves—particles no longer appeared in the picture at all. The new picture was not a mere amplification of the old—it ignored the old altogether and started anew on a clean canvas; and the new picture was strikingly successful. From this time on, there was not one single picture of Nature of which both waves and particles were constituents; there were two distinct pictures—one containing only waves, and the other containing only particles.

This and other occurrences have gradually made it clear that the material world consists of something which cannot adequately be described as either waves or particles. It is obviously something which cannot be grasped in its entirety by the human imagination, so that the best we can do is to represent it by pictures, each of which contains a partial, but only a partial, approximation to the whole truth. The mathematician has a specification of the constituent parts of the universe which he believes to be fairly complete. Looked at with care, and it will be seen that the universe consists of particles. Now let the mathematician go through the process which he will describe technically as "changing the variables", and look again. It is a specification of precisely the same universe, but it is present in an altered form, and we see now that it represents a series of waves—the particles have disappeared from the picture.

In general, it is true that we live in a mathematical universe, so that if we want the ultimate truth about this universe, or anything in it, we must go to the mathematician. When we regard the material world as made up of particles, we can obtain agreement with observation only by supposing that the motion of these particles is not fully determinate. The motion of any one single particle does not appear to obey any definite determinate laws, although the motion of a great number of particles is found to obey a quite definite statistical law. Indeed, it is from such statistical laws that the apparent uniformity of Nature proceeds. If, then, we confine ourselves to the particle-picture, we inevitably conclude that Nature in the last resort is not strictly determinate—somewhere there is an opening for new features to appear in the universe, although we do not know from whence they proceed or what causes them.

The wave picture, on the other hand, seems at first sight to tell us that Nature is strictly deterministic. The waves spread like ripples on the surface of water. Now such ripples follow a predetermined course, and from a knowledge of the ripples at any one instant, the mathematician can calculate what the motion of these ripples will be, and so what the configuration of the surface will be at any future instant. The determinism which we find in the waves is not one of motions or configurations of parts of the universe, but merely of our knowledge of these motions and configurations. If we acquire new knowledge of the universe, as for example by performing an experiment on any small part of the universe, this accession of new knowledge changes the total of our knowledge, and so changes the waves which represent this small part of the universe in the wave-picture.

The meaning of the determinism which is implied in the wave-picture now becomes clear. If we gain no new knowledge, our old knowledge remains our whole stock-in-trade for estimating the future course of events, whereas if we gain new knowledge we can estimate the future with greater precision. Thus the wave-picture does not proclaim that the course of Nature follows undeviating and unchangeable laws, but merely that our knowledge of Nature can only be altered by the acquisition of new knowledge. This is the only kind of determinism that we find in the wave-picture, and we see that it tells us nothing at all as to the actual course of Nature.

Both the particle- and the wave-pictures have been made to agree completely with Nature, but the particle-picture only by introducing a great number of restrictions and laws which appear to have only an artificial and even arbitrary basis. The wave-picture agrees with Nature almost automatically without any such artificialities; it is simple and complete in itself, and seems to fit the observed phenomena exactly. Thus we seem justified in regarding the wave-picture as our best representation of ultimate reality, while the particle-picture is only an artificial model, which is useful as a concession to the limitations of the human mind. Waves do not depict the electron, but what we know about the electron. They depict something inside our minds, not something outside. Thus the wave-mechanics give no countenance to the supposition that the electron has an objective existence independently of our knowledge of it—rather it suggests that our knowledge of the universe (or a bit of it) is fundamental, and that the electron is a clumsy creation of our own, resulting from our efforts to locate our universe in space and time. The apparent indeterminacy of the particle-picture becomes meaningless,

* Substance of the Sir Halley Stewart Trust Lecture delivered by Sir James Jeans, F.R.S., at the Memorial Hall, Farringdon Street, London, on October 22.

while the determinacy of the wave-picture has nothing to do with the course of objective Nature.

In brief, science is unable to give any decision—even to produce any evidence—in the long debated question of determinacy. We still may or may not be automata; science cannot prove that we are not, but it gives us no reason for thinking that we are.

Reviewing the history of science as a whole, we see scientific knowledge continually compelling man to lower his estimate of his own importance and position in the universe, until the beginning of the present century. It is perhaps still too early to form any judgment of more recent events, both because they are still so near at hand, and also because there is not yet complete agreement about them amongst scientific workers themselves. But it seems that the tide has begun to turn. In the light of recent knowledge gained from the theory of relativity and quanta, we seem entitled to take a more hopeful view of our position than Victorian science had been willing to concede. Man had formed a view of his position, influenced largely, no doubt, by his vanity and self-importance, but based on the whole of his practical everyday experience of life: he believed he was free to choose between the higher and the lower, between good and evil, between progress and decadence. Victorian science seemed to challenge all these beliefs: to it there seemed to be neither higher nor lower, neither progress nor decadence. The machine merely ran on automatically, and of its own inertia, as if it had been set to run on the first morning of the Creation and would continue so to run, following out its predestined course, to the end of time. We now begin to suspect that this challenge was a mistaken one. The universe is more like the untutored man's common-sense view of it than had seemed possible a generation ago, and we may not have been mistaken in thinking that humanity is free to choose between good and evil, to choose its direction of development and, within limits, to carve out its own future.

Epochs in Medical Research*

HARVEY'S "De Motu Cordis", though based on knowledge long available, as well as on new observation and experiment, found a world unready to accept its great discovery. Character and courage, in alliance with scientific genius, were needed to break through the mists of hallowed error, and to walk boldly into the light of a new epoch.

More important to medical progress than a discovery of such profound and lasting significance was the creation and display for all time of the method of discovery by experiment. In preaching this new principle of advancing knowledge, Harvey moved with the great spirits of his age. Though Harvey was a physician, most of his directly clinical observations seem to have been lost, with the political destruction of his papers during the Civil War. As an experimental biologist, he had contact with some who were to be among the original fellows of the Royal Society, founded five years after Harvey's death, with the aims which Harvey had so insistently advocated. After Harvey's discovery of the circulation, a solution of the next main problem of nascent physiology, the meaning of respiration, was dependent on progress in the new science of chemistry, and involved the discovery of oxygen. This, which was nearly attained by Boyle and his associates in the early years of the Royal Society, became obscured by the phlogistic theory for more than a century, until Lavoisier finally revealed the nature of combustion and respiration, and made possible the reunion of physiology with medicine.

To-day, as in the past, there are new domains opening to physiology which can only be explored by men trained in other disciplines than that of medicine. The result, as in the past, will be ultimately to infuse new life into medicine itself, provided that clinical medicine, in the hands of those whose first aim is to increase knowledge, remains and increasingly becomes an experimental science, as Harvey saw it.

Harvey's other and much longer book, "De Generatione Animalium", not only gives us further evidence of his genius as an observer, but also shows into what vague and fruitless speculations even he could wander, when he forsook his own precepts. In his suggestions, however, as to the meaning of supposed cases of spontaneous generation, he appears to have been far ahead of the prevailing ideas of his time.

It is fitting, in commemorating Harvey as the founder of experimental medicine, to consider certain recent phases of active development in that field.

We date the epoch of medical bacteriology from Pasteur and Koch. It left the causation of many important infections unsolved, and we witness to-day what may be the beginning of a new epoch as important for medicine, in the study of infective viruses beyond the range of detection by ordinary microscopy. Influenza is a recent addition to the list. In the dimensions of some of the most finely particulate viruses we seem to approach a borderland between organisation and colloidal dispersion, and perhaps to encounter a new order of vital phenomena.

The most general characteristic of the present epoch in medical research seems to be the growing dominance of chemical ideas and the success of chemical methods. Many hormones and vitamins, of which but a few years ago the very existence was merely a matter of indirect presumption, have been isolated, chemically identified, and even prepared by artificial synthesis. In immunology, embryology and in the physiology of muscular activity and nervous transmission, the methods and conceptions of exact chemistry are finding a rapidly growing application.

All aspects of medicine—diagnosis, treatment, prevention—are profoundly affected by this development. Are we at the beginning of a great new epoch, of a major advance? Or will physiology and biochemistry early find themselves halted and baffled by a complexity which their methods have revealed? We must be content to go forward in the faith of William Harvey, that "Nature herself is to be addressed; the paths she shows us are to be boldly trodden; for thus, and whilst we consult our proper senses, from lower advancing to higher levels, shall we penetrate at length into the heart of her mystery".

* Substance of the Harveian Oration delivered by Sir Henry Dale, O.B.E., F.R.S., before the Royal College of Physicians on October 18.

Nutrition and Catering

THE report of the Nutrition Committee of the British Medical Association, issued in November 1933, and reviewed in NATURE of January 13, 1934 (133, 53), was designed to determine the minimum weekly expenditure on foodstuffs which would maintain in health and working capacity families of various sizes. A supplementary pamphlet is now issued to be of practical help to the housewife*.

The translation of food schedules into appetising meals was first undertaken by teachers of domestic science who attended the summer school of the Board of Education in London in 1934. The B.M.A. specimen diet No. 16 for a man, wife and three children was the chosen model. Improvements were introduced to make more variety without increasing cost. Menus for the principal meals for three weeks have been planned, and the dishes for each day illustrated in colour. Shopping lists of food quantities and recipes are included, and a table of food values. Owing to local and seasonal variations in prices the total cost is not here estimated, but in the original report the average price was assessed at 5*s.* 5½*d.* per man weekly.

The American Medical Association has for many years concerned itself with teaching the public the principles of hygiene, including proper nutrition. We welcome this evidence that the B.M.A. is awakening to the fact that the fight against malnutrition is at the present time the most important problem in preventive medicine. The manner in which the information is presented in this pamphlet is simple and attractive, and beyond criticism, but the nature of the diet recommended is not so faultless. The principles of the newer knowledge of nutrition have not been applied; there is close adherence to the obsolete standards of the pre-vitamin era with the focus too exclusively on calories and an unnecessarily high total protein ratio. The supply of vitamins and minerals is sub-optimal. The proportion of fat, and therefore of fat-soluble vitamins, is admittedly low.

The sum allowed weekly for fresh fruits and vegetables has been cut down from the 2*s.* 6*d.* allowed in the first report to a scanty 1*s.* 11*d.* for a family of five; the amount of vitamin C is further reduced by pickling some vegetables. No advisory note is inserted that *wholemeal* flour and bread provide for the same money better value than white cereal products in respect to quality of protein, vitamins and mineral salts. If, as is probable, white bread, etc., are used, 60 per cent of the total calories are derived from over-refined foodstuffs lacking vitamins and deficient in mineral salts, and leading inevitably to malnutrition. Where money is short the best slogan is that advocated by Prof. Sherman, 'no calories without vitamins'.

The health value of this diet would be greatly improved by an increase of butter or milk and of green vegetables; by a decrease in sugar; by replacing white cereals, sago, etc., by whole cereals; by decreasing the total cereals and increasing the amount of potatoes. As a basis for planning healthy and inexpensive diets Dr. Mikkel Hindhede's book on health by correct and simple diet, reviewed in NATURE of June 22, 1935 (135, 1016), might with advantage be consulted.

* "Family Meals and Catering." Pp. 27 + 3 plates. (London: British Medical Association, 1935.) 6*d.*

Universities and Business Training

AT the discussion on "The Universities and Business" arranged by the Department of Industrial Co-operation, Section F (Economic Science and Statistics), at the British Association meeting at Norwich on September 5, Dr. J. A. Bowie discussed the need for more intimate co-operation and suggested that British university schools of business were supplying a negligible percentage of the men required for administrative positions in industry and commerce. Dr. Bowie estimated that over the whole of British industry there were about one million suitable appointments for the business graduate. If the British schools of business were supplying the administrative grade of employee at the same rate as the replenishment in the closed professions, they should be producing about 40,000 graduates annually instead of the actual 200–300.

It was not suggested that such graduates were entitled at once to a responsible managerial post, but the importance of finding them a progressive post leading to such positions was stressed. Dr. Bowie urged that the main reason for the low output of graduates from the university schools of business in Great Britain lay in lack of close working association between education and business. He considered that academic ideas had influenced too largely the commercial courses in Great Britain, which should be modelled on those of the medical school rather than the arts course.

University education for business should aim at giving the student a knowledge of the facts and principles relating to the nature and functions of business and our economic institutions; the capacity for disciplined thinking, for logical analysis and reasoning with respect to the problem of business and of modern society; facility in oral and written expression; an acquaintance with the operating tools of management such as general and cost accounting; and personal effectiveness including the capacity for job analysis and co-operation. At present Dr. Bowie considered that insufficient attention was paid to the development of facility in oral and written expression, the operating tools of management, and the development of personal effectiveness. The employer attached primary importance to the possession of desirable traits of personality and

character and to the capacity to co-operate effectively with others in the attainment of common ends, and the university should supplement its scholarship test by stimulating the development of such personal qualities, by inculcating right attitudes towards life and work and emphasising the need for disciplined habits of thought.

Dr. Bowie suggested further that the determination of the ideal curriculum for business training awaited the result of an inquiry which had yet to be made, and that industry in its turn should pay more attention to the training of its recruits and to definite schemes of promotion. The tendency for the universities to become too exclusively recruiting and training grounds for the professions was socially undesirable and economically disastrous.

Dr. Bowie's address provoked a lively discussion, particularly with reference to the curriculum of the university schools of business, and the place of economics in such training. Opinion was strongly expressed that it would be disastrous to confuse the academic study of economics and research in this field with preparation for a business career, and that the two were best kept distinct. Dr. Bowie himself suggested that economics was probably best studied at a final stage of a business training rather than as a basic subject for such training.

The whole value of such courses of training for business was challenged in the discussion and opinion was expressed that, provided the recruit entered business with a trained mind, it did not greatly matter whether that training had been given in a science or in an arts course. Business could always utilise the trained mind. Against this view it was pointed out that the transfer of knowledge and training was not high and such a policy might involve serious waste. A plea was made that something in the nature of refresher courses in business subjects on the lines of the post-graduate courses now arranged annually in a number of technical colleges and universities might be useful, and it is possible that the university schools of business may render some of their most important services to industry in the provision of such courses for those actually engaged in responsible administrative work. Somewhat surprisingly, despite Dr. Bowie's remarks, no reference was made to the tendency for administrative work itself to be regarded as a profession or at least to be influenced increasingly by professional ideals.

Educational Topics and Events

ABERDEEN.—Dr. William Hamilton Fyfe, principal and vice-chancellor, Queen's University, Kingston, Ontario since 1930, has been appointed principal of the University of Aberdeen, in succession to the Very Rev. Sir George Adam Smith, whose resignation will take effect on October 31. Dr. Hamilton Fyfe was, in 1919–30, headmaster of Christ's Hospital.

CAMBRIDGE.—D. H. Valentine, of St. John's College, has been appointed to the Frank Smart University studentship in botany.

At Girton College the Founders' Memorial Lecture will be given by Sir Frank Dyson on Saturday, October 26, at the College. The title of the lecture will be "The Discovery of the Solar System".

At Christ's College the following members of the College have been elected honorary fellows: Prof. Arthur Hutchinson, Master of Pembroke College and emeritus professor of mineralogy; Prof. J. Graham Kerr, M.P., emeritus professor of zoology, University of Glasgow, formerly fellow of the College; Prof. G. H. F. Nuttall, emeritus professor of biology and director of the Molteno Institute of Parasitology, formerly fellow of the College; Dr. A. W. Rogers, lately director of the Geological Survey, Union of South Africa, president of the Royal Society of South Africa.

With the withdrawal of the opposition, the offer of £10,000 to the University by Sir John Siddeley for the promotion of aeronautical research has been accepted by the Regent House. The *non-placet* was withdrawn in a fly-sheet in which the signatories explained that their attitude, when the offer was originally made in July, was that the money should be used only for work of a fundamental and non-military character. Prof. Melvill Jones, it is stated, gave in effect the assurance required, for he said that all work done in his department was published in the ordinary way and that Sir John's gift was unconditional. The supporters of the *non-placet* add that, since the promotion of human knowledge and welfare is the special responsibility of the University, "it should not even appear to be associated with work that has the destruction of civilization as its object". The suggestion is also made that the "University should define its position on the whole question of military, commercial and secret research, and that an early opportunity should be given for a discussion of this question".

OXFORD.—Dr. J. G. Priestley has been appointed deputy for the professor of physiology during the vacancy caused by Sir Charles Sherrington's retirement.

Dr. F. G. Hobson has been appointed Litchfield lecturer in medicine and Mr. H. A. B. Whitelocke Litchfield lecturer in surgery.

Dr. J. Marschak, All Souls' College, formerly of the Universities of Heidelberg and Kiel, has been appointed director of the new Institute of Statistics for five years from October 1.

Dr. L. H. D. Buxton has been appointed reader in physical anthropology for seven years from October 1.

FEDERAL aid for schools in the poorer regions of the United States is being urgently demanded on the ground that the existing system of school finance, based on the small school district, has, in many localities, completely broken down. "Our American school system is fighting for its very existence," said a member of Congress recently when introducing a Bill for establishing such a measure of federal participation in public instruction as would ensure a reasonable standard of education for every boy and girl in the Union. In support of his contention, he cited statistics showing that salaries of teachers amounting to more than 57 million dollars are in arrears, and that outstanding salary warrants non-cashable or subject to heavy discounts amount to nearly 50 millions. The resources available in the different States for the maintenance of schools differ very widely, and the years of industrial depression have strengthened the hands of the politicians who hold that the Federal Government should now take more responsibility for education.

Science News a Century Ago

Maury's Work on Navigation

MATTHEW FONTAINE MAURY (1806–73), the distinguished American meteorologist and hydrographer, wrote the first of his books, his work on "Navigation", while serving as master of the United States sloop *Falmouth*, to which he was appointed in 1831. It was during his voyage from New York to the Pacific that he conceived the idea of his celebrated wind and current charts.

Writing to his brother from Philadelphia about his book, Maury said, "Without wishing to excite your expectations, I will let you into the secret of my plans, which I wish you to preserve as a secret, in order that if I should not succeed in what I undertake, my friends and family may not feel the effects of disappointment. You must bear in mind that this is the first nautical work of science that has ever come from the pen of a naval officer; and upon its merits I intend to base a claim for promotion. Such a case has no precedent. Therefore you must look upon it as an experiment, in which I may or may not be successful. If I succeed, I shall be put over the heads of many who are now above me. . . . I wish to impress upon you that I am not sanguine of success, but am resolved to try every honourable means to accomplish the object, and to take the most favourable time for it. The book, I hope, will be out in about six weeks. . . ."

When Maury's book appeared, it was favourably noticed by the highest nautical authorities in Great Britain, and it became the textbook of the United States Navy.

Lindsay's Electric Lighting Experiments

ON October 30, 1835, a letter from James Bowman Lindsay on his electric light appeared in the *Dundee Advertiser*. "As a notice of my electric light," the letter ran, "has been extensively circulated, some persons may be anxious to know its present state, and my views respecting it. The apparatus that I have at present is merely a small model. It has already cost a great deal of labour, and will yet cost a good deal more before my room is sufficiently lighted. . . . I am writing this letter by means of it at 6 in. or 8 in. distant; and, at the present moment, can read a book at the distance of 1½ feet. From the same apparatus I can get two or three lights, each of which is fit for reading with. . . . Brilliant illumination will be obtained by a light incapable of combustion; and, on its introduction to spinning mills, conflagrations there will be unheard of. . . . Exposed to the open air, it will blaze with undiminished lustre amidst tempests of wind and rain; and, being capable of surpassing all lights in splendour, it will be used in lighthouses and for telegraphs. The present generation may yet have it burning in their houses and enlightening their streets. Nor are these predictions the offshoots of an exuberant fancy or disordered imagination. They are the anticipated results of laborious research and of countless experiments. Electricity, moreover, is destined for mightier feats than even universal illumination."

On January 15, 1836, Lindsay gave a lecture in the Thistle Hall, Dundee, on his experiments, and publicly exhibited his electric light.

Societies and Academies

PARIS

Academy of Sciences, September 16 (*C.R.*, 201, 510–512). JEAN LEGRAND: New data for the study of periodicity. Study of the periodic relations between rainfall, mean tide-level, and sunspots.

September 23 (*C.R.*, 201, 513–532). CHARLES RICHET: Notice on the work of the late Léon Fredericq. I. VINOGRADOV: The summations of H. Weyl. VLADIMIR KOSTITZIN: The intoxication of a medium by the catabolic products of a population. LÉOPOLD ESCANDE: Remarks on the perturbations maintained in resonance at the lower end of a water main. MAURICE ROBERT and JULES FOGLIA: The measurement of the flux in coils with iron core, and the realisation of a direct reading Henrymeter for any self-induction. GABRIEL VALENSI: The oxidisability of nickel. The results of experiments on the rate of oxidation of nickel foil are given graphically. The data can be expressed by the Arrhenius formula, $n = 11 \cdot 46^{-11210/T}\sqrt{t}$, in which n is the grams of oxygen fixed per cm.^{2}, T is the absolute temperature and t the time in hours. JEAN TIMMERMANS and GUSTAVE POPPE: The mutual solubility of heavy water and organic liquids. JACQUES DE LAPPARENT: The place of montmorillonite in the category of phyllitous silicates. RENÉ SOUÈGES: The embryogeny of the Verbenaceæ. The first terms of the development of the albumen in *Verbena officinalis*. JEAN MARIE LE GOFF: The differential biological reaction of cobalt compounds and of certain complex cobalt compounds (cobalt-ammines).

CAPE TOWN

Royal Society of South Africa, August 21. J. A. PRINGLE: Observations on certain wood-boring Coleoptera occurring in South Africa. C. VAN RIET LOWE: The Smithfield 'N' culture. Attention is directed to the wide range of artefacts employed by those who practised this variation of the main Smithfield culture. Sites and assemblages of artefacts are described, and it is suggested that this peculiar variation of the parent culture owes its characteristics to a changed environment—necessitating a change in employments and in consequence a new variety of tools—brought about by a migration and probably influenced by other cultures. A description is given of the diffusion of the culture, and the five marked, yet intimately related, variations of the common parent are linked up and explained.

SYDNEY

Royal Society of New South Wales, September 4. F. P. DWYER and J. W. HOGARTH: Oxidation of cobalt amalgam. Cobalt amalgam prepared by electrolysis is shown to have the composition, Co_2Hg_3. Although rapidly oxidised in the air to a mixture of Co and CoO, in the ratio of 3 : 1, it is perfectly stable in dry air, oxygen-free water, and inert gases. Cobalt suboxide, Co_4O, is suggested as an intermediate in the oxidation of the amalgam. The oxidation product readily reduces nitrites and nitrates in neutral solution to ammonia, and, on being freed from oxide by ammonium salts, gives a pyrophoric form of cobalt.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, October 26

BRITISH PSYCHOLOGICAL SOCIETY, at 3.—(in the Physiology Theatre, University College, Gower Street, W.C.1).—Dr. B. P. Wiesner: "Psychophysiological Studies of Animal Drives".

F. B. Kirkman: "Field Experiments with Birds".

Sunday, October 27

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Parasites".*

Monday, October 28

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—E. Barclay: "North American Deer".*

UNIVERSITY OF LEEDS, at 5.15.—Prof. S. Sugden: "Artificial Radioactivities".*

UNIVERSITY COLLEGE, LONDON, at 6.30.—Dr. R R. Marett: "Magic and Religion".*

Tuesday, October 29

ROYAL INSTITUTION, at 5.15.—Sir James Jeans: "Physical Astronomy" (succeeding lectures on November 5, 12 and 19).

WARBURG INSTITUTE, at 5.30.—Anatole de Monzie: "L'Idée Encyclopédique".*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. E. V. Appleton.*

Thursday, October 31

UNIVERSITY OF LONDON, at 5.—(at the Royal Society of Medicine, 1 Wimpole Street, W.1).—Sir St. Clair Thomson: "The Defences of the Air Passages" (Semon Lecture).*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. E. Mellanby.*

Friday, November 1

CHADWICK PUBLIC LECTURE, at 5.30.—(at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, W.1).—Dr. C. Killick Millard: "The Vaccination Question To-day".*

UNIVERSITY OF DURHAM PHILOSOPHICAL SOCIETY, at 6.30.—(at Armstrong College, Newcastle-upon-Tyne).—Dr. E. L. Hirst: "The Chemical Nature of Vitamins".*

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 7.—Eng.-Comr. C. J. Hawkes. "Heavy-Oil Engines for Ship Propulsion" (Andrew Laing Lecture).

ROYAL INSTITUTION, at 9.—Clifford C. Paterson: "The Liberation of the Electron: its Industrial Consequences".

Official Publications Received

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 524: The Cytology of Trisomic Mutations in a Wild Species of Œnothera. By Prof. R. Ruggles Gates and H. K. Nandi Pp. 227–254+plates 22–24. (London. Harrison and Sons Ltd.)

List of Whole-Time Awards for Scientific Research, other than Professorships, offered by Public and Private Bodies in Great Britain and Northern Ireland. Pp. 31. (London: Royal Commission for the Exhibition of 1851.) 6*d*.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 29th October 1935. Pp. 38. Newcastle-upon-Tyne: (Natural History Society of Northumberland.)

Principles and Practice of Field Experimentation. By Dr. J. Wishart and Dr H. G. Sanders. Pp. 100. (London: Empire Cotton Growing Corporation.) 3*s*.

Papers from the Geological Department, Glasgow University. Vol. 17 (Octavo Papers of 1934–1935). (Glasgow University Publications, 36.) 10 papers. (Glasgow: Jackson, Son and Co., Ltd.) [1210

Oxford University Exploration Club. Seventh Annual Report, 1934–1935. Pp. 23+2 plates. (Oxford: M. J. Dunbar, Sec., Trinity College.)

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries: Report for the Year 1934. Pp. 37+4 plates (London: H.M. Stationery Office.) 1*s*. net.

Universities Bureau of the British Empire. Report of the Executive Council, together with the Accounts of the Bureau for the Year 1st August 1934 to 31st July 1935. Pp. 20. (London: Universities Bureau of the British Empire.)

Other Countries

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 37, Part 3: Chemical Studies on *Rhizopus japonicus*. By Hoshik Lim. Pp. 165–209. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the American Museum of Natural History. Vol. 68, Article 6: Gazetteer and Maps showing Stations visited by Emil Kæmpfer in Eastern Brazil and Paraguay. By Elsie M. B. Naumburg. Pp. 451–469+plates 6–27. (New York: American Museum of Natural History.)

U.S. Department of the Interior: Geological Survey Bulletin 864-B: The Willow Creek—Kashwitna District, Alaska. By S. R. Capps and Ralph Tuck. (Mineral Resources of Alaska, 1933.) Pp. ii+95–113+1 plate. 5 cents. Professional Paper 177: The Gold Hill Mining District, Utah By T. B. Nolan. Pp. viii+172+15 plates. 1.25 dollars. Water-Supply Paper 657: Water Utilization in the Snake River Basin. By W. G. Hoyt. Pp. x+379+26 plates. 1 dollar Water-Supply Paper 741: Surface Water Supply of the United States, 1933. Part 1: North Atlantic Slope Basins. Pp. x+390. 30 cents Water-Supply Paper 752: Surface Water Supply of the United States, 1933. Part 12: North Pacific Slope Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp. vi+182. 15 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the California Academy of Sciences, Fourth Series. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. Vol. 21, No 22: The Vascular Plants from San Nicolas Island, California. By John Thomas Howell. Pp 277–284. Vol 21, No. 23: The Roccellaceæ, with Notes on Specimens collected during the Expedition of 1905–06 to the Galapagos Islands. By Otto Vernon Darbishire. Pp. 285–294+plates 16–17. Vol. 21, No 24: New Species of Grasses from the Galapagos and the Revillagigedo Islands. By Albert Spear Hitchcock. Pp. 295–300. Vol. 21, No. 25: The Recent Pectinidæ. By Leo George Hertlein. Pp. 301–328+plates 18–19. Vol. 21, No. 26: New Flowering Plants from the Galapagos Islands. By John Thomas Howell Pp. 329–336 (San Francisco, Calif.: California Academy of Sciences.) [1110

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 138: Tuberculosis of Buffaloes in Egypt with some Tuberculin-test Experiments. By Prof. Dr. M. Carpano. Translated into English by Dr. Zaki Mohamed Pp. 19+8 plates. 3 P.T. Bulletin No. 158: Anthrax Infection in Birds. By Prof. Dr. M. Carpano. Translated from the Italian by Elliot J Moreno. Pp. 18+4 plates. 3 P.T. (Cairo: Government Press.)

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1932. Pp. xiv+221. (Cairo: Government Press.) 40 P.T.

What is Nippon Kokutai: Introduction to Nipponese National Principles. By Chigaku Tanaka. No. 1. Pp. ii+16. (Tokyo: The Shishio Bunko.)

Commonwealth of Australia: Council for Scientific and Industrial Research Pamphlet No. 58: Certain Aspects of Investigations on Black-end Disease of Bananas in Australia. By Shirley Hoette. Pp. 22+1 plate. Bulletin No. 92: The Apple-Growing Soils of Tasmania. Part 1. A General Investigation of the Soils. by C. G. Stephens; Part 2: A Soil Survey of part of the Huonville District, by J. K. Taylor and C. G. Stephens. Pp 55+1 plate. (Melbourne: Government Printer.)

Carnegie Institution of Washington. Publication No. 464. Researches on Waring's Problem. By L. E. Dickson Pp. v+257. (Washington, D.C.: Carnegie Institution.)

Union of South Africa: Department of Mines. Geological Series Bulletin No. 5: The Nickel-Copper Occurrence in the Bushveld Igneous Complex West of the Pilandsbergen—a Preliminary Report. By C. M Schwellnus. Pp 36. (Pretoria: Government Printer.) 6*d*.

Indian Forest Records (New Series). Vol. 1, No. 3: Neue Brenthiden und Lyciden aus Indien. Von R. Kleine Pp. ii+73–78. 6 annas; 8*d*. Vol. 1, No. 4: Immature Stages of Indian Coleoptera (17) (Eucnemidæ). By J. C. M. Gardner. Pp. 79–93+2 plates. 4 annas; 5*d*. (Delhi: Manager of Publications.)

Bulletin of the American Museum of Natural History. Vol. 68, Art. 7: The Courtship of Gould's Manakin (*Manacus vitellinus vitellinus*) on Barro Colorado Island, Canal Zone. By Frank M. Chapman. Pp. 471–525. (New York. American Museum of Natural History.)

Catalogues

Dulau's Botanical Catalogue: Herbals, Floras, Monographs, Gardens and Gardening, Wild Flowers, etc. No. 239.) Pp. 52. (London: Dulau and Co., Ltd.)

Books and Periodicals on Zoology and Botany: including Publications of the British Museum and Works on and by Linnæus. (New Series, No. 41.) Pp. 58. (London: Wheldon and Wesley, Ltd.)

Livogen: Concentrate of Vitamin B complex with Liquid Extract of Liver B.D.H. and Hæmoglobin. Pp. 14. (London: British Drug Houses, Ltd.)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3444 SATURDAY, NOVEMBER 2, 1935 Vol. 136

Scientific Methods and the Advance of Social Conditions

Life and Leisure in London*

THE last volume of the great "New Survey of London Life and Labour" has now appeared. We noticed the first in NATURE of March 21, 1931, p. 430, and have now to add a word of hearty congratulation to Sir Hubert Llewellyn Smith and his staff on having brought their ship into port. It is a fine piece of work, and both the thoroughness of the execution and the general hopefulness of the conclusions will bring happiness to Mr. Charles Booth in the shades and to all his friends who remember the devotion and the insight with which he initiated and carried through the earlier survey forty years ago. That was a scientific expression of the humanitarian spirit, parallel to, and no doubt largely inspired by, the same ideas which had just founded Toynbee Hall, as the practical expression. Both movements have been followed by hundreds of successors in all parts of the world. It is one of the most interesting features of this new survey that its director, Sir Hubert Llewellyn Smith, had a hand in both the earlier experiments in the 'eighties and 'nineties of the last century.

The present survey was undertaken in 1928 by the London School of Economics, and has been supported by the funds of more research foundations and charities' trustees than we can find the space to enumerate. The money has been well spent, for the results, established with the utmost impartiality and marshalled with skill, are a permanent record of the contemporary state of the largest aggregation of human beings on the earth. It is formally limited to an area lying somewhere between the County of London and the Greater London which comes under the Metropolitan Police. It deals with a population of about five and a half million, though its results would be in the main applicable to a much larger area and are broadly typical of most great urban centres at the present time. Hence its high scientific importance as a sociological document.

This ninth, and last, volume of the work, dealing with life and leisure, will probably attract more general attention than any of the others, because of the multitudes involved in all the main activities which it describes. We all go at some time to the 'pictures'; the wireless is as popular a pastime with the well-to-do as with the poor. Indeed it might be said that this levelling up, or levelling down, of the whole population by the aid of mechanism, is the most outstanding feature of the whole report. When one sees the sort of personal activities by which the more vigorous individuals strive to win spiritually above the mass, it is clear how very similar are the tastes and efforts of all classes in the nation. They all take to a garden when they can. They all, in similar proportions, run their rowing, football and cricket clubs. They all, though in a still smaller proportion, endeavour to follow some form of serious study. Everyone therefore will feel that there is something to his own account in what purports to be an inquiry into the conditions of the 'working classes'.

One ought perhaps to make two partial exceptions to this wide conclusion, both mainly connected with difference of income. Drunkenness has markedly gone out, we are told; and gambling has very much increased. The former is certainly true equally of all classes. What the report relates, in this matter, of the working classes in

* The New Survey of London Life and Labour. Vol. 9: Life and Leisure. Pp. xiv+446. (London: P. S. King and Son, Ltd., 1935.) 17*s.* 6*d.* net

the last forty years, is only the social extension downwards of what had been going on among the well-to-do for more than a century. It may encourage us to hope for a similar diffusion of better tastes and wider interests in other matters. Cycling is another example of the same sort. But the vast increase in gambling seems exceptionally to belong to the wage-earning class. The chapter on this subject gives interesting and intimate accounts of how the betting business is actually carried on, and the fun which often arises from it in the family circle. As throughout the volume, the tendency is to look rather on the harmless and cheerful side, and, on the whole, it is both morally right and scientifically sound to do so. Clearly the life of the multitudes in the great urban centres is not generally degraded or unhappy, and the standard has risen very greatly in the period under review, both in comfort and in the pleasurable and harmless use of the increased leisure and material means which have accrued. This is the main point, and the surveyors take care to stress it, perhaps with a slight tendency to over-satisfaction. Those reading what they say will often reflect on the other side of the picture and sigh for the what might be. This rage for gambling, and the huge crowds which frequent the football matches, are one of the chief points which suggest such thought. The State is obviously justified in taking what measures it wisely can, to restrain the passion, when, as in the case of greyhound racing, a large new industry arises, consuming millions of money, in which practically the sole motive is stimulating gambling, already appealed to on many other fields.

The other most noticeable difference in the use of leisure, due mainly to difference in education and income, is the overwhelming preference for the cinema over the living drama or music. There are roughly three times as many cinemas as theatres and music-halls together, in the County of London, and no doubt the proportionate attendance in the former as compared with the latter would be greater still. When we consider that this includes the principal theatre area in the whole country, and that a majority of the towns in England have no theatre at all, worthy of the name, one must ask whether the State is justified in staying its hand, as it does, and treating all forms of amusement as equal before the law.

While holding firmly to the main principle that it is far better for people to do things for themselves than have them done by a State, however benevolent, one must recognise at the same time the duty, sometimes the necessity, for the authorities, who, after all, represent the deliberately constituted will of all, to intervene on occasions, to prevent a gross evil, to assist a better cause, to give, in fact, guidance rather than command. We do it rather too much in the schools, where the effort to inculcate a love and knowledge of the national classics—Shakespeare and Scott and others—has often the opposite effect to that desired. But, after the school-age, we go to the other extreme and tend to remain nationally indifferent, leaving to private enterprise the foundation of a national theatre, the encouragement of music, the employment of leisure. The more enterprising and intelligent of the public librarians endeavour to educate the taste of their readers; but such a policy of selection, though it seems to be having some effect in the quality of the books read, is by no means popular, and is actually disputed in theory by some quite serious people. "We pay the rates", it is said. "Why should we not have what we prefer to read?"

But the better opinion will surely be that there is room and full justification for further action, carefully devised and experimental, but not to be set aside on the vague denunciation of State socialism. The British Broadcasting Corporation, though tending rather to popularity in its programmes, is on the whole a successful move in the right direction. Where its resources have been used to maintain good concerts, open in the ordinary way to the public, it has been proved that there is a large and still unsatisfied taste for good music. The field here, with free and open-air concerts, is almost limitless.

On another—still wider—point, one is inclined to go beyond the terms of reference of these surveyors of London. One cannot look with complacency on the vast extensions of urban residence in connexion with our great cities, and especially with London; however much we may rejoice that the conditions of life are as much improved as the surveyors demonstrate. While tens of thousands of fresh residents are poured out each week to the suburbs of London, especially to the south, it has taken fifteen years of persistent and difficult contrivance to build up a community of a little more than ten thousand at a garden city (Welwyn) which is really in the country and offers advantages of a healthy, pleasant and natural life far beyond those of the best ordered urban area. Is there no scope here for further

strong and deliberate State efforts to mitigate the urbanisation of England and have a larger proportion of the people in country surroundings? It is a commonplace that the country is the natural home for childhood, and yet every decade for more than a century we have allowed a smaller proportion of our children to enjoy it.

Scientifically then, this "Survey" is invaluable, as confirming, by minute inquiry into a large typical area, the general conclusion which M. René Sand submitted to us recently in his magnificent "Economie humaine par la médecine sociale". That is, that a marked and demonstrable improvement has taken place in social conditions generally throughout the world, as a result of applying scientific methods deliberately to social needs. Both René Sand and this "Survey" fully admit the black spots, and the "Survey" studies these (for example, sex-delinquency and crime, in this volume) with the utmost care and sympathetic insight. But both authorities agree as to the main conclusion, and also that we may reasonably expect a further advance by pursuing the same methods, if possible with greater vigour.

Morally and politically, the "Survey" suggests some other large questions at which we have hinted above. Mechanism and the increase of leisure have given us a far larger population of tolerably well-off and semi-educated people, living in great and growing masses in urban areas in all industrialised countries. The supreme problem now faces us of how so to act that the highest human ideal may be opened to all, according to their capacity. This involves doubtless much well-directed collective effort. Still more it points to the cultivation by all sensitive and capable persons of a divine discontent with a falling off from the best, either in themselves or in those who share the common civilisation which we have inherited from the past. To keep this alive, and make it operative in ever-widening circles, must appear the highest moral and intellectual obligation on all with means of action; and every man has a certain field of action in himself. F. S. M.

Flow as a Property of Matter

First Report on Viscosity and Plasticity
Prepared by the Committee for the Study of Viscosity of the Academy of Sciences at Amsterdam. (Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam, Afdeeling Natuurkunde, (Sectie 1), Deel 15, No. 3.) Pp. viii+256. (Amsterdam: N. V. Noord-Hollandsche Uitgevers-Maatschappij, 1935.) 10 guilders.

THE problem of flow has diverse aspects. We have the flow of gases, the mechanism of which is tolerably well understood, so that in the case of certain simple gases the viscosity, and its variations with temperature, can be calculated. We have liquids, of which the viscosity is precisely defined by a constant and can be accurately measured: the mechanism of the flow is imperfectly understood, but it is certainly quite different from that of gases, as the contrasting effect of temperature in the two cases abundantly demonstrates. When we come to the movement of solids under stress, where even the definition of constants which shall describe the experimental facts presents grave difficulty, we are confronted with a still more complex problem. In general, a finite stress is needed to produce permanent set, but this appears to be about the only common factor of the behaviour of such different classes of bodies as polycrystalline metals, metal single crystals, doughs, clays, glasses, gels, rubber and living protoplasm, and in certain cases matters are made still worse by the phenomenon known as thixotropy, a term applied to the marked decrease of viscosity caused by shaking or similarly disturbing certain colloidal substances. The evident complexity of the problems long kept investigators from this field, but, within the last twenty-five years or so, serious attempts have been made to systematise our knowledge. Imperfect as our general theories still are, the time is definitely ripe for a collected and critical account of the present state of the subject, and all workers in the wide field will welcome the enterprise and applaud the courage of our Amsterdam colleagues in issuing the "Report" under notice.

The report deals with the measurement and physical significance of the different types of slow flow observed for liquids and solids, and excludes vortex motion. It opens with a general review of the field; a brief summary of the properties of the simple liquid is followed by an elegant description of Maxwell's theory of a relaxation time, which covers both true liquids and substances which definitely creep on loading and unloading,

although it is doubtful if any such substance quantitatively obeys Maxwell's original law. We then have what is probably the most complete and systematic description yet given of the various models that can be constructed of springs and damping cylinders (elastic and viscous elements), with the object of imitating the behaviour of true solids, reference being made to the electrical analogy in which resistance and condensers are the elements. With such models a rough general demonstration of the experimental effects can be given, but, once more, quantitative description leaves something to be desired. The work of the present writer has been so generously handled in the "Report" that he hesitates to refer to his suggestion, not here considered, that a rotating element, giving a "saturation value", if it may be so called, of the part of the flow which it contributes, may be usefully invoked in this field, and probably has a physical meaning.

A very full description is then given of Prandtl's model for explaining elastic hysteresis. This model is certainly elegant, but seems very artificial, demanding, as it does, regular rows of molecules slipping in the direction of the row, independent of the direction of the forces. It may have a physical significance when applied to single crystals, but it is difficult to see how it can represent very closely the state of affairs in, say, Chatterton compound, with which Braunebek has carried out experiments to verify it. Nevertheless, in view of the fact that it has not hitherto received much attention, at any rate in Great Britain, nobody will grudge the space devoted to it. The chapter, written by J. M. Burgers, closes with a sympathetic account of the present writer's attempt to formulate a theory of liquid viscosity. The whole chapter is clearly and concisely written, and the part dealing with the elements of the subject is a model of exposition.

The second chapter, likewise by J. M. Burgers, discusses the flow of some actual solids, and gives provisional definitions applying to the different stages, this classification being extended later, when the behaviour of polycrystalline metals is discussed. It is not, of course, possible to characterise plasticity by a single constant, but here and elsewhere in the report, notably in the chapter by C. J. van Nieuwenburg on the technical aspect of the subject, the use of what are called D-τ diagrams is emphasised, D being the steady rate of flow under stress τ. Such diagrams are naturally only possible when a constant rate is attained, and by their nature tell us nothing of the early hardening during flow under constant stress. The technical part of the report provides the physicist with a very interesting view of the significant work that is being done on industrial products, and should be of help to the technologists, especially as regards notation and expression of results.

H. G. Bungenberg de Jong deals with the flow of colloids, and provides much practical information. He restricts himself, however, almost entirely to dilute lyophilic colloids, which do not show the troublesome peculiarities of the more concentrated preparations. He also attempts to apply Einstein's theory to lyophilic sols, naturally without any striking success, since the conditions contemplated by Einstein are certainly not fulfilled, even approximately, in this case*.

One of the most valuable parts of the report is that in which W. G. and J. M. Burgers collaborate on the plastic properties of metals. They discuss the behaviour of polycrystalline metals under various loads in a more systematic way than is usual in textbooks, considering briefly the experimental facts of hardening under stress and age-hardening, and pointing out the significance, limited enough, of the experiments on the damping of vibrations of metal wires. Incidentally, they state that polycrystalline lead shows permanent deformation under even the smallest load, which is contradicted by the recent experiments of Bruce Chalmers. They then pass on to the plastic deformation of single crystals, round which so much discussion took place at the International Conference on Physics last year. Here, as with ordinary metals, one of the main problems is that of hardening under stress. The views of Smekal, Becker, Taylor, Orowan and others are discussed, but the statement that "it is not always an easy matter to arrive at a precise picture of the mechanism that the various authors have in view" will arouse a sympathetic echo in many breasts. The ingenious but somewhat artificial assemblages of flaws or dislocations as well as faults of other kinds can often be made to explain particular observations, but it cannot be said that the assumptions are always well established, or that a simple and convincing scheme has yet been produced. Even the appearance and distribution of the slip bands themselves are still imperfectly understood. The authors put forward a picture which is a combination of the Becker–Orowan theory, constructed to explain the dependence of the rate of flow on stress and temperature, and the Taylor theory, constructed to explain hardening. This is attractively presented and seems promising.

In the last chapter, H. J. Jordan deals with a subject unfamiliar to most physicists and chemists, namely, the mechanical properties of muscles. He distinguishes between the mainly elastic type of muscle, of which striated muscle is the general

* Dr. Eirich, of Vienna, recently described to me some very striking work, shortly to be published, which constitutes a great advance in this direction.

example, and the mainly plastic type, exemplified by the smooth muscles of hollow organs, strips of the cutis of holothurians being, apparently, the most convenient example for experiment. Various models, made up of elastic and plastic elements, effectively in series or in parallel, are discussed. Needless to say, the phenomena are extremely complicated and their interpretation difficult.

Although the book is written in English by Dutchmen, there are very few foreign turns of phrase, and none such as to render the sense in doubt. The general style is particularly lucid. The work, especially the part of it due to J. M. Burgers, alone and in collaboration with W. G. Burgers, is informed by a clear and critical spirit, and can without exaggeration be said to be indispensable to all workers in the subject. In the preface the prospect is held out of a second report, dealing in particular with problems of flow in colloidal structures. We trust that the reception of the report now before us will encourage the Committee to set about this task forthwith, and then to provide an index which will include the present volume.

E. N. DA C. A.

Botanical Nomenclature

International Rules of Botanical Nomenclature, adopted by the International Botanical Congresses of Vienna, 1905, and Brussels, 1910, revised by the International Botanical Congress of Cambridge, 1930. Compiled by the Editorial Committee for Nomenclature from the Report of the Subsection of Nomenclature prepared by John Briquet. (Règles internationales de la Nomenclature botanique) (Internationale Regeln der botanischen Nomenclatur.) Dritte Ausgabe. Pp. xi+152. (Jena: Gustav Fischer, 1935.) 7 gold marks.

BOTANISTS who are interested in precision in nomenclature have awaited with some impatience the publication of the new edition of the "International Rules of Botanical Nomenclature" which would embody the results of the deliberations of the International Botanical Congress at Cambridge in 1930.

Precise botanical nomenclature originated in the "Lois de la Nomenclature botanique" drawn up by Alphonse de Candolle and adopted after discussion by the Paris Congress of 1867. Though the 'laws' were widely accepted, differences of interpretation and usage rendered increasingly imperative in the course of years a revision and amendment. Such revision was the chief work of the Vienna Congress in 1905, completed at Brussels in 1910. In the meantime, however, an influential section of American botanists had promulgated a "Code of Rules" which, while based on the de Candollean laws, differed in some essential points from the Vienna rules, and this Code had been adopted by a proportion of American workers. The aim of the Cambridge Congress was if possible to unify procedure, and to clarify and, where necessary, amend the rules in the light of experience gained in the intervening twenty-five years. The discussions were marked by a general desire to come to agreement on the various points at issue.

The burden of the work of preparation for the discussions at the Congresses and the editing of the results, since 1900, had fallen on Dr. John Briquet of Geneva, nominated *rapporteur général*, but his regrettable death in 1931 occurred before he had drafted the new edition of the rules. It devolved, therefore, on the remaining members of the editorial committee (Prof. H. Harms, Prof. Al. Mangin, and Dr. A. B. Rendle) to prepare the revised edition from Dr. Briquet's report of the discussions published in the general report of the Congress (1931) and from notes taken at the Congress by the recorders. As certain 'proposals' presented to the Congress by a group of British botanists were the basis of many of the alterations introduced into the rules, the first draft was prepared by the English member of the Committee in consultation with some of the British botanists. This formed the basis of discussion by the Committee, and is followed in the volume by the French and German translations by Prof. Hochreutiner (*vice* Prof. Mangin) and Prof. Harms respectively. Prof. Harms, as *vice-rapporteur*, acted as general editor.

Generally speaking, the alterations in the new edition are framed to render the rules more precise and easier of application. One result has been a sub-division of some of the rules, which now number twenty-four as compared with fifty-eight in the earlier edition. Greater precision is given to the conservation of names of certain genera to avoid disadvantageous changes by strict application of laws of priority; the nomenclature of hybrids and half-breeds is rendered more explicit; also the rules governing valid and effective publication, and those determining the selection of names when groups are divided, remodelled, transferred or united. An important addition is the insistence on nomenclature types as determining the names of taxonomic groups—

the type is that element of a group with which the name of the group is permanently associated. An alteration, the effect of which had not been adequately appreciated, was introduced into the rule dealing with homonyms. A saving clause was an addition to the final rule by which modifications accepted at one Congress remain on trial until the next, at which they will receive sanction unless undesirable consequences show need for further amendment or rejection. A supplement provides a list of proposed additions to the names of genera to be conserved and also lists of standard species typifying such genera.

The volume as published by Messrs. Fischer conforms in size and character of text with the two previous editions emanating respectively from the Vienna and Brussels Congresses of 1905 and 1910.

Epidemics and Crowd-Diseases

Epidemics and Crowd-Diseases:
an Introduction to the Study of Epidemiology. By Prof. Major Greenwood. Pp. 409. (London: Williams and Norgate, Ltd., 1935.) 21*s*. net.

THE value of a scientific treatise lies not so much in the information which it imparts as in the inspiration which the reader derives from it to inquire further into the matters with which it deals. We have read "introductions to the study of" subjects, which left the impression that nothing remained worth inquiring into, and even destroyed all desire for such exercises. In his work on "Epidemics and Crowd-Diseases"—which will become a classic—Prof. Greenwood, far from doing this, introduces his readers to the study of epidemiology in such charming fashion that, as the tale unfolds, each chapter seems to end on a note of lively interrogation.

The volume is divided into two parts, general principles and methods, and special illustrations. The first four chapters, dealing with the history of epidemiology from Hippocrates and Galen through Graunt and Farr to the present time, and two chapters in the second part dealing with Jenner and Creighton, provide continuous entertainment as well as instruction, this being due to their literary style rather than their subject matter. The chapters on experimental epidemiology, artificial immunisation, nutrition, and the influence of occupation and of psychological factors upon crowd-diseases, are masterly essays, all too brief, on our knowledge of these matters. The special illustrations chosen are the typhoid group, cholera, typhus, measles, diphtheria, scarlet fever, smallpox, plague, epidemic diseases of the central nervous system, influenza, venereal diseases, tuberculosis and cancer. It is impossible to do more than enumerate these chapters, each of exceptional interest and critical value. A wealth of satire, not overdone and certainly salutary in its effects, pervades these chapters, as indeed the whole work, and adds pleasure to the reading.

The greatest living exponent of the application of the statistical method to epidemiology might be pardoned if he exaggerated the services which statistical research has rendered to the progress of medical knowledge; but Prof. Greenwood might rather be accused of under-estimating the achievements of statistical epidemiology and of undue pessimism as to the possibilities of such research in the future. In the opening chapter, for example, he tells us that so far as epidemics of catarrhal disease, common colds and pneumonias are concerned, we know scarcely any more than Hippocrates did about their general etiology. Again, in his account of "The Age of Pasteur and Galton", he asks whether the new statistical calculus has yet solved any of the age-old problems of secular variation, change of type or method of spread of infectious diseases; and having answered this with an emphatic negative, passes to the depressing conclusions that "we do not know enough of the elements of the subject to be fit to ask questions" of Dame Nature, and "at present, with all our knowledge of detail, we shall not reach the general 'laws' which Sydenham failed to discover".

It is difficult for us in this analytical period to 'see the wood for trees' sometimes. Our knowledge of the individual factors which combine to make the general etiology of crowd-diseases so complex becomes every year more complete, and when analysis has proceeded far enough—a tedious process seeming to our foreshortened vision to lead us farther from the solution of the general problems rather than nearer—the time will come when to some fresh mind with a genius for synthesis the fitting together of the carefully sorted pieces will appear amazingly simple. Perhaps the first steps in this synthesis are not so far away as Prof. Greenwood thinks; without doubt they will be brought nearer by the inspirations derived from the publication of such a work as this.

P. STOCKS.

Discoveries: Old and New

Unrolling the Map: the Story of Exploration
By Leonard Outhwaite. Pp. xiv+351. (London: Constable and Co., Ltd., 1935.) 16*s*. net.

THE appearance of yet another history of exploration may be taken to indicate a popular demand for such works and, if one may judge from some of his remarks, Mr. Outhwaite writes primarily for the general reader. He disarms criticism by confessing that he does not "pretend to refinement in historical scholarship" and generously acknowledges help both from distinguished scholars and from previously published works. As he frankly admits, there is little originality in his book. Its facts are in the main accurate, but he seems to have found the limitations of space very hampering, and many parts of the later chapters are little more than notes on explorers grouped under a general heading, such as "Others in Africa". This limitation has other curious results, such as the inclusion of all the work of the Duke of the Abruzzi in the chapter on the Arctic, and the relegation of "mountain explorers" to an appendix to that chapter. These are perhaps mere faults of arrangement.

There are, however, two serious criticisms to make of this work. Its title suggests a progressive development of the knowledge of the world which is not in accordance with facts. Until quite recent times, there were too many 'secret' discoveries and too many national or personal jealousies to make it possible for anyone to say how much of the world was known at any one time. Mr. Outhwaite may know now—but explorers, like, say, Columbus on his fourth voyage, would have given a good deal to see a map of the world as it was known to their contemporaries.

Mr. Outhwaite further attempts to illustrate his ideas with a series of maps. It is not quite clear what these maps are intended to show, but if the general statement in the introduction is applicable to all maps then there are many serious errors in the book. On many of them the whole of Newfoundland is shown as 'known', whereas in fact inland journeys were practically unknown until relatively recent times. There is much more of the world 'known' in 1490 than there is when Vasco da Gama made his voyage to India. In some of the maps showing the exploration of Africa in the nineteenth century there are similar errors. In short, the map does not unroll itself in quite the way Mr. Outhwaite intended, and when, as sometimes happens, his own statements do not agree with the maps, the reader is left in confusion. Nor is he helped in his search for a solution by the bibliography, which in the main consists of "a few volumes that will tempt the fireside explorer". Some at least of the distinguished authors quoted would perhaps be a little suspicious of such comfortable popularity.

It has been necessary to criticise Mr. Outhwaite's book partly because the publishers claim that it will be welcome to "students in need of a work of reference". It will, in fact, give them little help. On the other hand, the "schoolboy eager for one of the greatest true stories of adventure" and the "general reader" will find it, despite its awkward format, interesting, readable, and, up to a point, instructive. Even the student may study with profit the admirable drawings of ships, contributed by Mr. Gordon Grant, which combine art and scholarship in a manner which is much to be commended.

J. N. L. B.

Ornamental Shrubs and Trees: their Selection and Pruning
By Arthur J. Sweet. Edited by Walter P. Wright. Pp. xiii+64. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 5*s*. net.

OWNERS of gardens, large and small, will find this book very useful, for many people fail to get the best results from their shrubs and trees owing to their indifferent knowledge of pruning. All ornamental shrubs and trees do not need annual pruning; some give better results without it, others require an annual light thinning out of the older wood, and some respond most satisfactorily when the flowering branches are cut back each year after the flowers are over and entirely new wood is relied upon for future flowers. Moreover, some shrubs and trees can be pruned when they are dormant in late autumn or winter, but if the same treatment were given to others the flowering wood for the following season would be cut out; that is why the autumnal clean up of gardens should not be made the time for the annual pruning of shrubs and trees.

In the book under notice all the little peculiarities of different shrubs, regarding pruning, are dealt with, and by the aid of descriptive lists and diagrams it need not be difficult for the most casual amateur to find out the proper time and most approved method for pruning his shrubs and trees.

Theoretische Grundlagen der organischen Chemie
Von Prof. Walter Hückel. Band 2. Zweite Auflage. Pp. viii + 338. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 15.60 gold marks.

VOL. 1 of the second edition of Prof. W. Huckel's work was recently reviewed (NATURE, March 9, 1935, p. 384); vol. 2, divided into two main sections, contains a not inconsiderable amount of new material and there are certain changes in the presentation of the subject.

The first section (Book 3) on "Constitution and Physical Properties" contains the larger proportion of the new material included in the volume. This new material deals with dipole moment and with colloid problems in organic chemistry which, apart from the polysaccharides, are chiefly concerned at the present time with polymerisation of unsaturated simple compounds to products of high molecular weight. The author has purposely omitted to include the consideration of the physical basis of optical activity, a subject in which so much original work is being carried out particularly in England and in Germany at the present time.

Book 4 is concerned with various aspects of "Constitution and Velocity of Reaction" treated largely from the kinetic point of view. In this, not very much new matter is included, although there has been a rapid increase in our knowledge, particularly of the mode of reaction of simple organic molecules in the gaseous phase, since the publication of the first edition.

There is no doubt that Huckel's "Theoretical Principles" is a most stimulating work, in spite of the necessary restrictions which the author evidently feels it desirable to impose in a work of this kind; in his *Ausblick*, after referring to the work of Heisenberg and Schrodinger, the author indicates the importance of the application of quantum mechanics to the organic chemistry of the immediate future.

C. S. G.

An Introduction to Experimental Embryology
By Dr. G. R. de Beer. Second edition. Pp. xii + 148. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 7*s*. 6*d*. net.

THE appearance of a second edition of de Beer's "Introduction to Experimental Embryology" is evidence of its well-deserved popularity. The book deals with the whole subject of modern research into the form changes of animals. The field is so wide and the subjects touched on so varied, that perforce a very large number of experimental facts have to be included. It is Dr. de Beer's particular merit to have provided an exposition which is at once perfectly clear as to the actual data and also never loses sight of the main principles involved.

The achievement is the more remarkable as in point of fact there is no generally recognised set of principles extant which can be applied over the whole field. The author has had to select boldly, from the conflicting hypotheses which are available, one main thesis to which he can refer his experimental data. Dr. de Beer chooses the axial gradient theory, which has the somewhat dubious advantage of being so flexible that it can be more widely applied than many of the more specialised theories. Apart from any consideration of its ultimate scientific worth, however, it fulfils very well the function it is called upon to play in this book—the function of providing a connecting thread on which the data of experimental embryology can be strung together to make an interesting and not too mysterious story for beginners. If the vagueness which still attaches to the theory stimulates the reader to try to make precise in his own mind some of the questions which are raised, that too will have been not without its usefulness.

A Bibliography of Two Oxford Physiologists: Richard Lower 1631–1691, John Mayow 1643–1679.
By Prof. John F. Fulton. Pp. 62 + 7 plates. (Oxford: Printed at the University Press, 1935.) n.p.

THIS work is a reprint from the *Proceedings of the Oxford Bibliographical Society and Papers* (4, 1; 1935). Prof. Fulton states that he has chosen this subject owing to the recent interest caused by Dr. K. J. Franklin's studies on Lower and Prof. T. S. Patterson's critical discussion of Mayow's work. In a short introduction to Lower's bibliography, Dr. Franklin adds some supplementary matter to his previous studies, and maintains that the pre-eminent position occupied by Oxford in scientific achievement during the seventeenth century was due among others to Lower, who was alike great as an anatomist, physiologist and medical practitioner. Dr. Fulton himself has an equally high opinion of Lower, whom he regards as the foremost English physiologist of the seventeenth century after Harvey. On the other hand, he agrees with Prof. Patterson that Mayow has been credited with many things which had been definitely mentioned by other people, though he emphasises the fact that Mayow was the second English writer after Glisson to publish a treatise on rickets with novel and praiseworthy suggestions concerning orthopædic treatment.

The bibliographies of the two physiologists are each divided into three sections devoted respectively to their separate works, of which facsimiles of the title pages are inserted, contributions to other works, especially the *Philosophical Transactions*, and biography and criticism.

La Tchécoslovaquie: étude économique
Par Prof. André Tibal. (Collection Armand Colin: Section de géographie, No. 183.) Pp. 224. (Paris: Armand Colin, 1935.) 10.50 francs.

PROF. TIBAL'S economic survey of Czechoslovakia is mainly concerned with agriculture and the country's industries, but reference is incidentally made to educational, cultural and scientific matters. The book is most noteworthy for its account of the influence of the world economic crisis upon national life, and the methods that are being pursued to overcome the general stagnation. It is significant that the industrial and political leaders have sought the aid of men of science and have adopted some of their suggestions in attempts to surmount their difficulties. They are already meeting with a measure of success.

Solar Magnetism

By Dr. George E. Hale, For. Mem. R.S., Mount Wilson Observatory, Pasadena, California

THE recent celebration of Prof. Zeeman's seventieth birthday offers a favourable opportunity to describe current applications of his powerful method of research to the study of solar magnetism. Our latest results include the completion of the first observed 23-year magnetic cycle of sunspots and the conclusion of a long investigation of the sun's general magnetic field, made for the purpose of checking beyond question the original measurements begun in 1912.

ZEEMAN EFFECT IN SUNSPOTS

As explained eleven years ago in NATURE[1], I was led in 1908 to the discovery of magnetic fields in sunspots by a hypothesis based upon the results of two series of studies, begun at the Kenwood Observatory in 1890, and continued at the Yerkes and Mount Wilson Observatories. The first of these related to the nature of various phenomena of the solar atmosphere revealed by spectrographs and spectroheliographs. The hydrogen flocculi, as first shown by the $H\alpha$ line at Mount Wilson in 1908, indicated the existence of immense vortices surrounding sunspots, and suggested that electrically charged particles might be whirled within the spots in such a way as to produce appreciable electric currents. Such currents would set up magnetic fields, possibly of sufficient strength to be detected by a powerful spectroscope. Zeeman had shown how the spectrum lines of luminous metallic vapours between the poles of a magnet are widened or split into several components, polarised in distinctive ways. Meanwhile our studies of sunspot spectra, supplementing those made with less powerful spectrographs by Young, had reached a point where many lines on our photographs were not only widened but also separated into apparent doublets or triplets. These had previously been regarded as reversed lines, due to the superposition of two vaporous layers of different temperature and density. Such reversals actually exist in certain cases, notably in the lines of hydrogen and calcium. Thus, the true understanding of the sunspot spectrum had been obscured.

In the hope of disentangling the question, a new attack on sunspots was begun. Aided by the 60-foot tower telescope on Mount Wilson, equipped with a 30-foot grating spectrograph and suitable polariscopic apparatus, it was easy to test my hypothesis. The presence of magnetic fields was readily established in all the sunspots observed, and the polariscopic phenomena of the sunspot lines, varying as the solar rotation changed the angle between the lines of force and the line of sight, was quickly found to harmonise with Zeeman's laboratory results on the spectra of vapours. My solar work was greatly facilitated by experiments made in our own laboratory by King, provided with a Du Bois magnet and all the essential equipment.

MAGNETIC POLARITY OF SUNSPOTS

The sunspot spectrum contains many thousands of lines, and its complete investigation is an extensive task. After a sufficient number of these lines had been examined in order to establish the existence, strength and general character of the magnetic fields, another phase of the problem was attacked.

Speaking broadly, sunspots in the northern hemisphere of the sun were found to be opposite in polarity to those in the southern hemisphere. But occasional apparent exceptions indicated the need for a more careful analysis. The earliest drawings of sunspots, made by Galileo and Scheiner, suggest their complex character. They often appear at first as single spots, but soon develop into groups, frequently containing many components, large and small. No observer could fail to detect, however, a remarkable tendency of spots to occur in pairs, consisting of large spots with small companions, or of two groups of small spots. Here was an interesting chance for polarity tests, which showed that such pairs are almost invariably bipolar: that is, they consist of two spots or groups having opposite magnetic poles. The smaller spots that frequently cluster about the preceding (western) and following (eastern) major spots usually agree in polarity with the larger spots they accompany, though this is not an invariable rule.

From such characteristics a scheme of magnetic classification developed, which has been used ever since on Mount Wilson in recording the magnetic phenomena of thousands of spots examined with

the 150-foot tower telescope and the 75-foot spectrograph. This long task, in which Nicholson, Ellerman, Joy and many others have taken part, has now covered more than two of the well-known sunspot cycles of approximately eleven years duration.

Law of Sunspot Polarity

It is well known that the first spots of each of these 11-year frequency cycles break out in comparatively high latitudes some time before the last of the spots of the previous cycle disappear near the equator. From 1908, the spots of the then existing cycle continued to show the same polarity, opposite in the two hemispheres, while slowly decreasing in mean latitude. Not long before the minimum of solar activity in 1912, the forerunners of the next 11-year cycle began to appear. To our surprise, their polarity was opposite to that of the spots of the preceding cycle. Moreover, the succeeding spots of the new cycle, which overlapped for a time the remnants of the old cycle in lower latitudes, retained the same reversed polarities for approximately eleven years. Then another frequency cycle commenced, with another reversal of polarity. Thus the complete magnetic cycle, bringing back spots of the same polarity as those first observed, occupies some twenty-two or twenty-three years, and comprises two frequency cycles. The northern and southern hemispheres represent this novel effect with opposite signs. The diagram shown in Fig. 1 summarises the changes of latitudes and polarities during the period 1908–35.

A more detailed examination of the observations, many of which have been published in the *Astrophysical Journal* and the *Publications of the Astronomical Society of the Pacific*, would suffice to show that occasional exceptional phenomena complicate the explanation of these changes. About ninety-seven per cent of consistent results, however, obviously point toward some general solution, applicable to the sun and countless other stars, but still remaining in the form of the empirical law illustrated in Fig. 1.

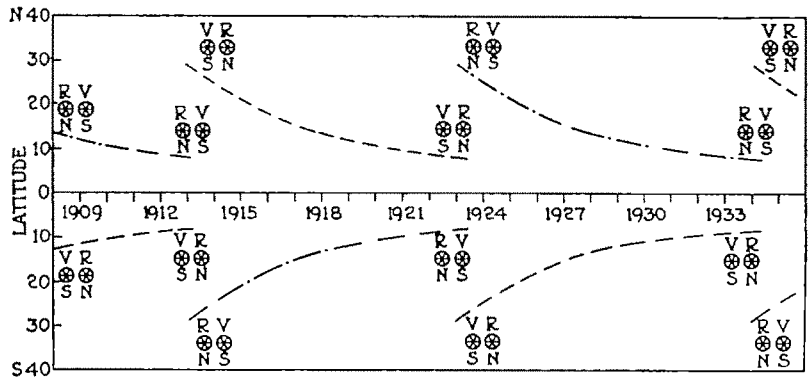

Fig. 1. Law of sunspot polarity. The curves represent the approximate variation in mean latitude and the corresponding magnetic polarities of sunspot groups observed at Mount Wilson from June 1908 until January 1935. The preceding spot is shown on the right.

General Magnetic Field of the Sun

Soon after the detection of strong magnetic fields in sunspots, I began to wonder whether the sun as a whole might possess a general magnetic field. There was no very promising theoretical ground for such speculation, but the magnetic field of the earth, with poles not far removed from the poles of rotation, was at least suggestive. Schuster had queried in 1891: "Is every rotating body a magnet?" and the structure of the solar corona resembles that of a magnetic field*. Thus while it was a far cry from the solid earth to the vaporous sun, it seemed worth while to undertake a trial.

The first attempts, made with the 60-foot tower telescope, were fruitless. In 1912, with the completion of the 150-foot tower telescope and 75-foot spectrograph, a better opportunity offered itself. Obviously no such widening and complete splitting of lines as had been found in sunspots existed in regions away from spots. But by using a purely differential method, comprising a compound quarter-wave plate overlying a long Nicol prism on the slit, it seemed barely possible that minute magnetic displacements of suitable lines might be detected by measurements on successive strips. Assuming the magnetic poles of the sun to correspond with the poles of rotation, and mounting the quarter-wave strips with their principal sections alternately at angles of $+45°$ and $-45°$ with the slit of the spectrograph, the displacements on

* In the present brief statement no attempt is made to enumerate other speculations and theories.

odd and even strips should attain maximum values on the central meridian at about 45° north and south latitude, and decrease to zero at the poles and equator.

In the search for such minute displacements, every precaution was taken to obviate any possible bias on the part of the measurers. Thus the quarter-wave plates were frequently inverted, and the measurer was never allowed to know in advance in which position they stood, nor the hemisphere or latitude of the photographs under measurement.

Great difficulties attended this investigation, which was continued for several years. Many members of the Mount Wilson staff joined me in the task, including Seares, Anderson, Ellerman and van Maanen, together with Miss Lasby, Miss Richmond and Miss Felker, while check measures and tests were made by Adams, Babcock and others. Several different types of measuring machines were employed, and every possible means of avoiding personal or instrumental errors was adopted. The results, fully described in a series of papers in the *Astrophysical Journal*, seemed to leave no room for doubt regarding the existence, polarity and approximate strength of a weak general magnetic field of the sun, having poles lying within a few degrees of the sun's poles of rotation.

The fact remains, as pointed out in these papers, that some of the many measurers engaged in the work could not detect the general field, though the results of all those who succeeded were in agreement regarding its polarity and order of magnitude. The difficulties of measurement can be appreciated only by those who have endeavoured to detect such minute displacements of lines, rendered broad and diffuse by the great dispersion employed. The observed displacements ranged from zero near the equator and poles to maximum values of 0·001 A. at mid-latitudes.

Several years ago I renewed this investigation with the cœlostat telescope (equivalent focal length 150 feet) and the 75-foot spectrograph of my solar laboratory in Pasadena. Having made a new series of photographs of the same dispersion as those previously taken on Mount Wilson, I endeavoured to measure them by several different instruments, including a Zeiss microphotometer and a tipping plate micrometer of the form used in our earlier work. The results showed little, if any, general magnetic field, and finally I thought it advisable to undertake new check measures of the plates made more than twenty years ago on Mount Wilson. More difficulties were encountered, and most of the experienced measurers who had overcome them before were no longer available. However, others kindly enlisted, and a study lasting four years has at last yielded a sufficient number of independent confirmations to satisfy us of the validity of our former conclusions.

As before, some of the measurers have been unable to detect the general magnetic field shown by our old plates. On the contrary, Dr. John Strong with an improved Zeiss microphotometer, used visually, and Dr. R. M. Langer with the original tipping plate micrometer, have found systematic average displacements of the same sign. Mr. J. Evershed, who very kindly volunteered to assist, obtained excellent confirmatory measures of our original plates at his observatory in England, using his own admirable method of measurement. Within the last few weeks [date of communication, September 14, 1935], Dr. Langer has obtained two more unmistakable confirmations with the aid of a new type of combined measuring, recording and computing machine, built in my laboratory after a design due chiefly to himself. The chief advantages of this machine are its speed of operation, permitting a very large number of measures to be made in a short time, and its complete freedom from any possibility of bias.

Taken altogether, the evidence is overwhelmingly in favour of the existence, polarity and order of magnitude of the general magnetic field of the sun given in our original papers. There is thus far no evidence of change of polarity at sunspot minima. As for any possible changes of intensity, every single determination is necessarily based upon thousands of measures, and hence represents mean values for many points on the sun. Thus much time may elapse before the question of variability can be settled.

The striking magnetic phenomena of sunspots, and the evidence we have offered that the entire sun is a magnet, would seem to have important bearings on the problems of terrestrial magnetism and the fundamental nature of magnetism itself. It is difficult to avoid the belief that the strong magnetic fields of the spots, and the much weaker general magnetic fields of the sun and the earth, arise from the same general cause, namely, the rotation of bodies carrying electrically charged particles. Many different hypotheses based upon this view have been tested, but there is much room for further work. While this will naturally deal at first with the simplest general assumptions, a detailed study of such anomalous phenomena as are presented by about three per cent of all sunspots should not be overlooked.

[1] "Sun-spots as Magnets and the Periodic Reversal of their Polarity", NATURE, 113, 105, Jan 19, 1924.

The Schools and Pre-Medical Studies

IN NATURE of July 20, 1935 (136, 90), appeared an article upon the recent report on the medical curriculum* dealing with the report from the point of view of clinical studies, but making no reference to the pre-medical studies and their relation to the work carried on in public and other secondary schools. The present article, which deals with this section of the report, is intended to be supplementary to that previously published.

The third section of the report deals with the pre-medical studies and may be briefly summarised as follows:

1. The period of pre-medical studies is spent with increasing frequency at school and only too often general education is stopped at too early an age in order to permit specialisation in science for passing the pre-medical examination.

2. In some cases, this has resulted in the formation of small groups working solely for this object, and thus segregated some, not only from the rest of the school, but even from other boys studying science.

3. The early specialisation is undesirable and could be avoided if a reasonable proportion of time was spent on science throughout the school period.

4. Greater use should be made of the Higher School Certificate examinations as a means of obtaining exemption from the First M.B. examination.

5. A common syllabus in chemistry, physics and biology is desirable for all First M.B. examinations, and suggestions for such a syllabus are given in the appendix to the report.

6. To ensure sufficient time for general education, and to avoid too early specialisation, medical studies proper, that is, anatomy and physiology, should not be begun before the age of eighteen.

It appears desirable to examine these criticisms and the suggestions, and to do so it is necessary to review briefly the work carried on in public and other secondary schools at the present time.

In the majority of schools, the work of the pupil is directed to attaining the standard of a School Certificate examination at the age of 15–16 years, and up to this stage in most schools there is little or no specialisation, each pupil commonly offering English, at least one other language, elementary mathematics, and from two (minimum) to five (maximum) additional subjects, usually including some science subjects.

A large number of pupils leave school when they have passed the School Certificate examination, but those intending to study medicine stay for an additional one or two years, and naturally their academic interests are centred mainly on their first professional examination. If these candidates have offered chemistry and physics (and possibly biology) for the School Certificate examination, and assuming they are about 16 years of age, it should be a matter of comparative ease for them to reach the standard of the First M.B. examination at the end of a further two years work without any intensive preparation, and the formation of special M.B. classes appears quite unnecessary.

Unfortunately, there are frequently complications so far as individual pupils are concerned. For some reason, it may be ill-health, slower development, or failure to pass the School Certificate examination at an earlier attempt, a pupil may already have reached the age of 17 years before becoming a post-certificate student. The tendency then will be for him to endeavour to pass his First M.B. examination at the end of a further year's work, a proceeding which must entail some intensive preparation and which probably segregates him to some extent from the rest of the science students.

In large schools, there is often also the difficult problem of a boy, who, having spent his time on the classical or modern side up to School Certificate stage, decides to study medicine. He has probably done little or no science, but is now transferred to the science side, and the problem becomes one for the science masters. To expect the boy to work with students of the science side who have already spent about three years working at science subjects is unreasonable, and therefore a special course of study has to be planned for him. Since this boy is endeavouring to pass in two years (or in extreme cases in one year) the same examination over which the preparation of the science side student has taken four or five years, the course of study is necessarily intensive, and demands all the time of the student, and even then the knowledge gained is in many cases superficial, and the examination is passed through the cultivation of a retentive memory rather than of scientific method. The general education of such a student must suffer, and if there is more than one pupil in such

* Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum. Pp. ii+34. (London: University of London, 1935.) 1s.

an unhappy position, it is easy to see how special M.B. classes arise.

As the report points out: "If all schoolboys and girls devoted a reasonable proportion of their time throughout the school period to the natural sciences there should be less need for a prolonged period of intensive preparation at the end of school life".

Putting on one side the special cases considered in the preceding paragraphs, one may now inquire: What provision is made for the continuation of the general education of post School Certificate students? Some specialisation is now inevitable, and as the report states "may not be undesirable", for those remaining at school usually have some definite objective, either a professional examination or a university scholarship, and the general work of these students is usually directed towards a Higher School Certificate examination. In this, a candidate is required to satisfy the examiners in a particular group of studies, for example, classical studies, modern studies, mathematics, or natural sciences, but, in addition, he has also to satisfy the examiners in at least one subsidiary subject which is quite outside the group in which he has specialised. This avoids, to some extent, undue specialisation, and it is probably in recognition of this fact that "the Conference would, however, approve of greater use being made of the Higher School Certificate Examinations as a means of obtaining exemption from the Examinations for the 1st M.B. or Basic Sciences".

Here again arise difficulties which could easily be removed. In some cases, a university will not recognise the possession of the Higher School Certificate of another university for exemption from the First M.B. examination. To take a definite illustration, a boy attending a school taking the Oxford and Cambridge Joint Board examinations can obtain exemption from London Matriculation by a suitable School Certificate of the Joint Board, but finds that he has no means of gaining exemption from the First M.B. examination at London by the Higher Certificate of the Joint Board, and his easiest course is to work for the First M.B. examination. There is no incentive for him to work at subjects other than the science subjects of the First M.B. and therefore his general education virtually ceases. If greater recognition was given by all universities to Higher School examinations for purposes of exemption from their own examinations, difficulties such as these could be avoided.

The need for a common syllabus for all First M.B. examinations has long been apparent to teachers who have been faced with the preparation of individual members of the same class for different First M.B. examinations. The difficulty may be made clearer by a consideration of the biological syllabuses of the First M.B. examinations of Cambridge and London. Since the introduction of the new syllabus in 1935 into the Cambridge examination, there is more in common than there was formerly. Thus in each syllabus the following types are mentioned: *Amoeba*, *Monocystis*, *Paramecium*, *Lumbricus*, *Scyllium*, *Rana*, *Lepus*; *Spirogyra*, *Pythium*, *Saccharomyces* and Bacteria. Peculiar to London are *Obelia*, *Hæmatococcus*, malarial parasite amd the flower structure of *Lilium* and *Pisum*; and to Cambridge: *Chlamydomonas*, *Protococcus*, *Polytoma*, *Pandorina*, *Eudorina*, *Volvox*, *Fucus*, *Hydra*, cockroach, and frog embryology. Truly, as is stated in the report, "the training would be more efficient if these differences, none of them great or important, could be removed".

Appendix A of the report presents a suggested common syllabus for the subjects of the First M.B. examination. It may not be out of place at this point to pause and consider the proposed syllabuses. In the preparation of the report, the representatives consulted various authorities from medical schools, and also headmasters and representatives of the Science Masters' Association; and it may be assumed that pre-medical studies were fully discussed, and the syllabuses given in Appendix A are the outcome of those discussions. The standard of work outlined by the syllabuses appears to be roughly that of the present First M.B. examinations, that is, somewhat lower than that of the Higher School Certificate examination in the separate subjects. This is probably wise, for whilst it will allow a candidate who has offered science subjects in the School Certificate examination to take his First M.B. examination with fair prospects of success at the end of a further year's work (a benefit to the older post-School Certificate student already referred to), it will probably require two years' careful work from a candidate who has previously done little or no science, unless he is 'crammed' for this particular examination, a deplorable event, but practically impossible to eradicate, since parents' wishes must be respected.

If the recommendation that medical studies proper should not be begun before the age of 18 years is carried into effect, then there will be little incentive for the post-School Certificate student of 16 years to take the First M.B. examination the following year, and he can continue the normal school course for a further two years and attain the somewhat higher standard required from Higher School Certificate candidates, providing his success will gain for him exemption from the First M.B. examination. The syllabuses will probably be well received by teachers, to whom the

adoption of the syllabus by all authorities is of greater importance at the present moment than the details of the contents.

It may be predicted, therefore, that the recommendations of the report so far as they are concerned with the pre-medical studies and the age for commencement of medical studies proper will receive the enthusiastic support of teachers in public and other secondary schools. If the recommendations are carried into effect, the complaints of undue specialisation and too low a standard of general education will largely disappear, and the medical students produced by the schools may be better fitted to "acquire that kind of culture which survives the forgetting of facts".

W. J. R. D.

Geology as a School Subject

AT the Norwich meeting of the British Association, a discussion was held in Section C (Geology) on "Geology in Schools". It was certainly appropriate that this subject should be discussed during the year in which Prof. W. W. Watts is president of the Association, for during a period of more than thirty years he has repeatedly pressed the claims of geology as a school science subject, and his presidential address to Section C in 1903 dealt comprehensively with the functions of geology in education. For various reasons, little progress has been made with the introduction of the subject into schools, although in the meantime there has been a great extension of science teaching.

The Norwich discussion may be summarised the more easily since it revealed a remarkable unanimity of opinion, practically all who spoke emphasising their agreement with the previous speakers. It was keenly felt that geology does not occupy the place to which it is entitled in the educational system, in schools, universities or in the wider field of adult education. Dr. A. K. Wells showed that the number taking geology in the University of London General Schools Examinations has fallen almost to zero. On the other hand, many speakers emphasised the fact that geology proves one of the most attractive sciences when once a student is introduced to it. As Prof. Watts said: "there are many types of mind to whom this science appeals as no other one does": it gives a new interest which frequently lasts beyond school days, and which gives meaning to every piece of country visited, an important fact in these days of wider travel. Prof. P. G. H. Boswell stressed the value of geology as a cultural subject, and quoted Mr. Ramsay MacDonald's statement that "if any one of the sciences were selected as the key to all the other sciences—as that which in its subject-matter and its history, the history of its evolution, enforces the true scientific method—geology might be selected as that science".

In the course of the discussion, many advantages of geology as a school subject were touched upon. Among these the most important appears to be that geology is perhaps the very best training ground in the collection and co-ordination of observed facts. It was also emphasised that the equipment necessary for teaching (more abundant and more easily obtained now than at any time) is probably less expensive than in any other science. Many rural schools are situated in areas which can be described as natural laboratories, and it is preposterous that scholars do not learn something of the meaning of these surroundings. On the other hand, Dr. H. D. Thomas referred to the valuable work in geology done in a London school, so that the teaching of the subject by no means needs to be confined to rural areas. Prof. A. Hubert Cox spoke of the excellent work now being done in some Welsh schools, and Mr. A. N. Thomas gave an account of the courses provided at Caerphilly.

It was also pointed out that in several sciences taught in schools the teaching has become increasingly dogmatic: even the experiments performed are "carefully designed to eliminate all confusing and collateral elements". At least some teachers of chemistry and physics consider that the elementary parts of those subjects must be mastered as quickly as possible, and that it is impossible for a student until he approaches the standard of an honours graduate to begin to assess for himself the real value of experimental evidence or to develop his originality and critical ability. There is a real danger that a pupil finishing his science training in school may have acquired a vast body of scientific information, but may have had little chance of developing that scientific outlook which is likely to make him a more valuable member of most communities. In geology, on the other hand, it is still possible for a beginner to feel the excitement of making new discoveries; a fossil or a dip observation in a temporary section may be vitally important. The co-ordination of such observed facts, and the examination of alternative hypotheses concerning which the

teacher is prepared to admit his own uncertainty, are all part of the training of the most elementary student.

Other changes in school organisation in late years have, however, affected the question of what sciences ought to be taught. In the first place, the great extension of the senior classes in elementary schools has opened up a new field. The teachers in these schools, to a large extent freed from the tyranny of examinations, have opportunities of devising courses in science on more original lines; often limited by lack of laboratories and apparatus, the teaching of science must become even more dogmatic unless it is extended to include subjects such as geology in which the provision of simple equipment offers no difficulties: moreover, as Prof. Watts emphasised, it is possible to do a considerable amount of geology without any special knowledge of other sciences.

In the secondary schools the position presents greater difficulties. The teaching is frequently dominated by examinations; the needs of the small proportion of pupils who may eventually proceed to the university to a large extent determine the subjects chosen; the curriculum is already crowded, at least so far as the School Certificate stage. But many educationists feel that all is not well with science teaching at this stage and that the tendency to early specialisation imposes serious limitations on the teacher. Recently the panel of investigators appointed by the Secondary Schools Examinations Council concluded that "at present the practice is to confine Science work too narrowly and this practice is encouraged by our examination system". They believe that "there is a general body of knowledge . . . which ought to be known both by the ordinary citizen and by those who may ultimately specialise" in some narrower field, and recommend the institution of a course in elementary or general science to be made obligatory for practically all candidates desiring a pass in science at the School Certificate examination. The scheme now proposed involves some physics, chemistry and biology; in the course of the discussion at Norwich the view was very strongly expressed that some geology should be included in this general course.

The difficulty, already widely discussed, of making a homogeneous subject out of this new group would not necessarily be made greater by the inclusion of geology. For geology occupies a central position among the sciences, having close contact with all, and it was suggested that the geology would help to synthesise the scheme. In many cases it would form a suitable basis for the study both of science and of the external world. In this connexion, Prof. H. H. Swinnerton referred to a Nottingham school where a course in local geology and biology forms the starting point of all science work.

Several speakers felt that the introduction of geology as a separate subject after the School Certificate stage, for Higher School Certificate pupils, was highly desirable. The higher work done in school represents for some pupils the last stage of organised study, for others it forms the basis of subsequent university work; but for both these groups the inclusion of additional science subjects in the curriculum of most schools is greatly to be desired. Usually not more than three subjects are studied to this higher stage, and often in smaller schools no more than that number of science subjects is available: the pupil's choice at best is limited, and he may be excluded from any course in 'science' because, for example, of a distaste for physics or mathematics. For those who are not likely to proceed to university work in science, the advantages of a scheme which includes geology will be apparent from the remarks already summarised.

It was pointed out that the case of the student who intends to go to a university to read science calls for still more consideration, for the position has been greatly altered by the growth of the Higher Certificate courses. In most universities satisfactory school work at the higher stage gives exemption from first year university courses. But whereas in the past a matriculated student going to the university had to choose (usually) four science subjects from a list of seven or eight, which mostly involved taking up at least one subject which he had not studied at school, the present student has already made his narrower choice at school. There is a probability, therefore, that students who may have marked abilities in sciences not taught at school may never discover that bent, and may indeed be deterred from reading science at all. The effect of these conditions on the geology departments at the universities was commented on, although obviously this in itself is no strong reason for instituting geology courses in schools.

The relations of geology to the geography taught in schools were also discussed by several speakers. Prof. A. Gilligan emphasised the importance of geological work as a basis for school geography, and Dr. M. E. Tomlinson gave her experience, as a geography teacher, of the great interest taken by both boys and girls in the geology which she had, of necessity, introduced into her geography lessons.

The president of the Section (Prof. G. Hickling) mentioned that a sectional committee had been appointed to consider questions affecting the teaching of geology in schools. A. E. T.

Obituary

Mr. A. Thorburn

WITH the passing of Archibald Thorburn, who died on October 9, at the age of seventy-five years, ornithology has suffered a grievous loss. For a generation his pictures of bird-life held a supreme place in the presentation of our native birds; and this because he combined the rare gift of scientific accuracy with a sense of composition and colour-values, rarely attained by any other artist in this field. He knew his birds and loved them, and this goes far to explain his success.

Some of Thorburn's finest work is seen in his pictures of birds which appealed to the sportsman. His illustrations in Lilford's "Coloured Figures of the Birds of the British Islands" made him famous, for they were gems of the first water. He also painted a large number of pictures of pheasants for a great monograph on these birds published in the United States many years ago, as well as most of the coloured plates in the fine monograph of our British game-birds, written by his old friend J. E. Millais. This was no small tribute to his genius, for Millais himself had won fame in this field.

From his own pen followed two sumptuous books, each in two volumes, illustrated by himself. One of these was devoted to British birds. The other, in every way worthy of its predecessor, followed later, on British mammals. His exquisite pictures of field-mice and other small rodents and insectivores have never been equalled; and his wonderful drawings of whales seem to vibrate with life. These two books will remain an enduring monument to a great artist. His sure grasp of colour-effects he probably inherited from his father, who in his day enjoyed fame as a painter of miniatures.

The world is the poorer by Thorburn's death. To the wife and son who survive him, his friends and that great host who knew him only by the treasures from his pen and brush, will extend their profoundest sympathy. W. P. P.

Mr. E. G. Hooper

MR. EGBERT GRANT HOOPER was born at Bath on July 2, 1855, and died on September 17, 1935. As a pupil of Frankland at the Royal College of Science, he was a brilliant student and acquired that knowledge of chemistry which he used to such advantage in his later career. In 1878 Grant Hooper joined the Government Laboratory at Somerset House, and was transferred with it to its present quarters off the Strand. While in the Laboratory, he was engaged in food, drug, and water analysis, and assisted the late Dr. James Bell in his pioneer work on the analysis of foods.

In 1881 the tax on malt was changed to a tax on beer, and this gave Grant Hooper the opportunity of utilising his knowledge of the chemistry of brewing. It is not too much to state that Grant Hooper's small textbook, the "Manual of Brewing", was one of the earliest to consider the art of brewing in the light of the chemical knowledge at the date of its publication. It continued in use by students up to the present century and passed through several editions. It was fortunate too, in this connexion, that Grant Hooper was an expert microscopist. His wide experience enabled him to carry through many official chemical investigations of importance, ranging from the determination of arsenic, to lead in paints.

In 1912 Grant Hooper was appointed Deputy Government Chemist, a position he occupied during the difficult War period until his retirement in 1919. He was an active member of the principal chemical societies, on which he served by acting on their councils and committees. Among his various offices were those of vice-president of the Institute of Chemistry and chairman of the London Section of the Society of Chemical Industry. Those who worked with him will always remember his readiness to help in difficulties and to place his wide knowledge at their service. J. J. F.

Dr. P. K. Kozloff

THE death is reported of Dr. Petr Kuzmich Kozloff, the well-known Russian explorer, which took place at Leningrad on September 27 at the age of seventy-two years.

Kozloff was a pioneer in the band of travellers, who, combining geographical and archæological exploration in the objective of their expeditions, during the last forty years have traversed the Gobi Desert from end to end, and have restored to Western knowledge the vanished civilisations of Central Asia. Among these, the greatest honour will always be due to Sir Aurel Stein and Sven Hedin; but the Russian expeditions to Turkestan at the close of the last century were among the first to show the way to the sand-buried cities of these now desert lands, from which English, French, German and Swedish expeditions have brought back a priceless store of the treasures of ancient Asiatic art and culture.

Kozloff had already been a member of two important expeditions when he led his own first expedition to Central Asia in 1899. This was followed by a number of explorations in the Gobi Desert in the years preceding the War, of which the most fruitful was that of 1907–9, when he discovered the dead city of Khara Khoto, with its well-preserved remains of buildings and its evidences of an unknown race, from which he brought back the relics of a library, including writings in an unknown language. Under the Soviet Kozloff made several further expeditions to the Gobi Desert, of which the last was in 1926. In 1923, with the assistance of the Soviet Government, he published a fully illustrated account of his explorations and of Khara Khoto.

News and Views

Prof. Hans Spemann

THE Nobel Prize for Medicine for 1935 has been awarded to Prof. Hans Spemann, professor of zoology in the University of Freiburg-im-Breisgau. The presentation is a fitting recognition of a series of investigations which have transferred a large group of phenomena from the domain of metaphysics to that of science, in a way which we are more used to associate with the eighteenth century than with our own. Since his earliest papers, written at the turn of the century, Spemann has devoted himself to the problem of why one part of an egg develops into a certain organ in the adult, another part into something else. When he began his investigations, there was no scientific answer to such questions; one had the choice of invoking, with Driesch, a non-material entelechy, or of putting one's trust, with Roux, in the physics and chemistry of the future. Spemann refused such theoretical flights. He restricted his speculation to the actual data he could obtain from experiment, and his experimentation again to an intensive study of the development of one group of animals, the Amphibia. After twenty years of research, remarkable alike for the clarity with which the problems were envisaged and the beauty and skill of the technical means by which they were attacked, he was able to demonstrate that, in the amphibian egg, the way in which any part develops is dependent on its position relative to a certain region which he named the organisation centre. The formulation of this concept provided the first step in the causal analysis of the differentiation of the several regions of the egg. But Spemann was not content to leave the organisation centre as an unanalysed biological entity. He proceeded to show that some, at least, of its effects are due to its chemical properties, the nature of which he is still actively investigating, in company with his pupils and many others who have followed him in the exploration of the rich country which he has opened up for science.

Prof. E. Maitland Wright

DR. EDWARD MAITLAND WRIGHT, who has been appointed to succeed the late Prof. H. M. Macdonald in the chair of mathematics at the University of Aberdeen, is only twenty-nine years of age. He took his degree at the University of London in 1926 with first class honours in mathematics. He was a scholar of Jesus College, Oxford from 1926 until 1930 and has been a research student in mathematics at Christ Church since. He gained both the Junior and Senior Mathematical Scholarships of the University and first classes in each of the mathematical 'schools'. He has also been a University Senior Student and, for one year, lecturer in mathematics at King's College, London. He was trained in research work in mathematics under Prof. G. H. Hardy in Oxford and Prof. Landau in Gottingen. He has published nearly twenty papers, mainly on the additive theory of numbers and especially on Waring's theorem. A book by Prof. Hardy and him will shortly be published by the Oxford University Press; it will be accurately, though, perhaps, deceptively described as "An Introduction to Arithmetic".

The New Physics

IN the Sir Halley Stewart Trust Lecture delivered on October 24, Sir William Bragg said that an important factor in the rapid progress of science, so marked in recent years, has been the discovery that in one of her chief aspects Nature's constructions are essentially 'particulate'. In the first place, matter is particulate. The atomic theory as now understood dates from the time of Dalton, who established the fact that atoms, of a limited number of kinds, combine in definite numerical proportions to form the substances of the world. This great generalisation is the foundation of chemistry. Forty years ago it was shown that electricity is also particulate, the ultimate unit, when of negative sign, being called the 'electron'. These two generalisations have prepared the way for a third; it has been found that energy may also be described as 'particulate'. The transfer of energy is effected in units, known as 'quanta'. It is now possible to demonstrate the single atom, though a hundred million in line cover only an inch, the single electron and even the single energy quantum. Accurate maps of various molecules can be drawn, showing the signs and positions of the atoms of which they are composed: just as an architect draws the plan of a building. We may study the single ring of six carbon atoms which, with attached hydrogens, forms the molecule of benzene, or the double ring of naphthalene and the treble ring of anthracene, these being of great importance in the dye industry; or the five-ringed structure which is typical of most of those substances that are known to produce cancer. We can examine the details of the long protein molecule which plays so great a part in animal life, or the cellulose molecule of plants, or the arrangements of the atoms in metals and rocks. Nature builds all the substances that we know on certain definite structural lines. It is because we have learnt this fact, and are learning how to follow, very haltingly it may be, that physical science is making such rapid headway.

Atmospheric Electricity

IN the third of the series of Sir Halley Stewart Trust Lectures on "Scientific Progress", on October 29, Prof. E. V. Appleton dealt with recent advances in the study of atmospheric electricity. The surface of the earth is negatively charged in fine weather, while the air immediately above possesses a positive

charge. Measurements made over the oceans by American observers in the non-magnetic ship *Carnegie* showed that there is a maximum effect all over the world at the same universal time (7 p.m. G.M.T.). It is now believed that the maintenance of the earth's charge is due to thunderstorms, which send an appreciable amount of negative electricity into the ground. In the upper atmosphere, the electrification is a thousand times denser than it is in the lower atmosphere. The marked solar control of the density indicates unmistakeably that the ionisation is due to solar radiation, and radio observations show that the cause of the electrification is ultra-violet light. A difference in the behaviour of the lower and upper levels of the ionosphere has been recognised recently. The lower stratum is found to be about twice as dense in summer as in winter, due to the more direct influence of sunshine. This is exactly the amount of variation predicted by theory. But for the higher region there is not the expected increase in summer. To account for this anomaly the theory has been put forward that, at a height of 150–200 miles, the atmosphere is raised to a high temperature by the sun. Expansion results from this heating, so that the electricity is attenuated in density. To account for the observed facts it appears necessary to assume that at this level the summer noon temperature is at least 2000° F. The density of the ionosphere appears to follow the sunspot cycle of 11 years. The minimum of solar activity occurred about the latter half of 1933, and both magnetic and radio observations now show that activity is increasing again. It is expected, as a result, that the radio-engineer will find substantial differences in the wireless wave-lengths best suited for long-distance communication.

Science Exhibition at Liverpool

THERE was a record attendance at the fifth public exhibition and soirée arranged by the Associated Learned Societies of Liverpool and District at the Liverpool Technical College on October 26. The exhibition was opened by the Lord Mayor of Liverpool, and the Mayor of Bootle attended; they were received and shown round the exhibition—twenty-six rooms arranged by twenty-three societies comprising more than two thousand members—by the president, Dr. H. J. W. Hetherington; chairman, W. Mansbridge; deputy-chairman, W. S. Laverock, and the secretary, Miss E. Warhurst. Lectures included: "Race, Place and Nationality in Europe" by Prof. P. M. Roxby; "Value of Milk in Nutrition" by Prof. H. J. Channon; "Spiders and their Silk" by S. T. Burfield; and "Recent Work on Vitamins and Hormones" by Dr. R. A. Morton. The Society of Chemical Industry showed films of crystal growth by H. Emmett, and citrous fumigation with cyanides. The bird room arranged by Eric Hardy included a working scale model of a proposed bird observatory or ringing-station for migration study in the area, the first photographs taken of the grey phalarope in Great Britain—by members of the Ornithological Section of the Liverpool Naturalists' Field Club—and a working model of a ship's oil separator as the solution to the waste oil menace to sea-birds. Dr. C. T. Green of the Liverpool Botanical Society exhibited an extensive series of hand-coloured photographic prints of British orchids, similar to his noted collection recently accepted by the British Museum. Diagrams and photographs from Bidston Observatory were shown by the Liverpool Astronomical Society, and short talks were given on meteorology and astronomy. Dr. W. B. Wright, district geologist of H.M. Geological Survey, showed his results of spore analysis of coals at the Liverpool Geological Society's room. There were also demonstrations and exhibits by the leading scientific firms and the Liverpool Corporation Electric Department.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions to the Department of Zoology is the Bird collection of reptiles and amphibians from eastern Asia Minor. This collection, consisting of 196 specimens, contains representatives of one new subspecies of lizard and of two others not previously represented in the Museum's collections. It is of especial interest as coming from a region which is comparatively little known and which is intermediate, both geographically and faunistically, between the better-known regions of Iraq and western Asia Minor. A collection of 280 land snails from Cyprus has been purchased and is of interest in connexion with an intensive study which is being made of insular variation in the land Mollusca of various Mediterranean islands. The Department of Geology has received the Pleistocene vertebrate remains (chiefly mammals) which have been collected by Dr. L. S. B. Leakey in considerable quantity and from a large number of localities in East Africa in the course of his recent expedition. Purchases for the Department include a number of rare fossil fishes from the Middle Eocene of Bolca, Italy. The Mineral Department has received by gift from Mr. V. Koren a specimen of gold in quartz from Tanganyika Territory; from Mr. E. E. A. Leach a large crystal of platinum, showing magnetic poles, from Potgietersrust, Transvaal; from Dr. R. Kirkpatrick a series of moldavites, mostly collected by himself, from Czechoslovakia; and from Dr. Germaine Joplin a series of rocks from Ben Bullen, New South Wales. The purchases include a series of Brazilian minerals, among them being a large, pale blue and white, zoned, tabular, and waterworn crystal of topaz, a cut citrine (yellow quartz), weighing 647·35 carats, a large cut, pink and green tourmaline weighing 57·47 carats, a golden beryl crystal, and several specimens of quartz. A cut lemon-coloured orthoclase, weighing 31 carats, has also been bought.

THE Department of Botany has received from Mrs. E. G. Wheelwright the bryological herbarium of the Rev. H. E. F. Garnsey (1826–1903). The collection contains 2,300 mosses mostly British. Though Garnsey's name is best known on account of his association with the translations of German botanical textbooks issued by the Oxford Press, he had a high reputation

as a bryologist. The herbarium of Robert Paulson has been presented by his widow. It contains more than six hundred flowering plants, but its value is in its 269 British and 200 foreign lichens, for Mr. Paulson was one of our best known amateur lichenologists. Mr. A. H. G. Alston, assistant keeper in the Department, recently visited southern Albania in company with Mr. N. Y. Sandwith, of the Kew Herbarium. About 550 numbers were obtained. The Lunxheriës Mountains and Mount Tomori were explored, and further collections were made about Voskopoj. A visit to Gur-i-Topit was forbidden by the authorities because of a revolution. The main interest in the collection is that it was made at a late season of the year when little exploration has been done in the region. It also supplements the previous collections made in Albania by these botanists. The herbarium of Maurice Depierre has been purchased. It consists of about 23,000 specimens representing the flora of Mont Blanc and the other mountains in the Haute Savoie, collected in the first half of the last century. It contains specimens collected by the Curé's friends, MM. Puget and Chevalier, and some of the labels are made out or verified by the celebrated Prof. Reuter, who published a catalogue of the plants of Geneva.

Trees and Health

As the subject of his Chadwick Public Lecture on October 23, Mr. R. St. Barbe Baker discussed "The Contribution of Trees to National Health and Efficiency". He commenced by tracing the history of trees on the globe, showing that in early times trees of certain species were regarded as sacred, a superstition of man—if indeed it were a superstition—which survives to the present day, since many jungle races still worship the forests, or trees in the forests. Mr. Baker correctly states that man has been a destroyer of trees and the forest for a long period in his history. This destruction in the early days of man was justified to enable him to obtain space for pasturing his flocks and raising crops; with the increase in numbers, however, the destruction and wasteful utilisation of the forest proceeded apace, resulting in the disappearance of ancient civilisations owing to the former prosperous lands becoming a desert. As Mr. Baker shows, this wanton waste of the resources of the earth is continuing at an increased pace, owing to the greater demands being made upon the lands for agriculture and other purposes by an increasing population at the expense of the forest. Mr. Baker's remarks on the subject of the French and British in West Africa concerning the forests and the advance of the Sahara are somewhat misleading. The French are in fact carrying out forestry work of considerable importance and high technique in West Africa. In Nigeria a very considerable recognition exists of the problems connected with agricultural methods, forests, the increasing desiccation, and so forth.

Two other points in connexion with Mr. Baker's lecture are worthy of note. Under certain conditions, trees and the health of man are closely connected. In most of the temperate parts of the world under salubrious conditions of land and climate this is true. Mr. Baker must, however, be aware that in certain parts of the globe it is far from the truth. Medical opinion in West Africa, for example, now holds that sleeping sickness due to the tsetse fly is increased by the presence of trees on the ground. Large belts of trees around towns and along main roads are now felled, and the area kept clean with the object of reducing the disease. Generalities are always dangerous. Many have welcomed the 'Men of the Trees' and the effort the Society stands for. At times, however, Mr. Baker would seem to forget that a Forestry Commission has been established in Great Britain and has now been carrying out excellent afforestation work for some fifteen years; also that many landowners throughout the country possess parks containing beautiful trees. It is not that the love of the tree is not deeply implanted in the British peoples. The trouble arises from the fact that the general public does not know or understand how to raise young trees. One has only to look at the trees upon some of the arterial roads to realise that there is little use in planting trees in Great Britain unless proper provision is made for their supervision. It would be a fine thing if the members of the Society which Mr. Baker represents would, individually, plant twenty-five trees on Armistice Day in this Jubilee year. But who is going to look after these trees for say the next fifteen years? Without such attention, how many will be alive at the end of two to three years? If the 'Men of the Trees' can solve the question of how young trees, planted in public localities in Great Britain, are to be properly tended until they have reached a size and height beyond the ordinary dangers to which the young standards are exposed, we shall be on the road to replacing in our generation what our forefathers have given us in the wonderful old trees to be found in this island.

Births and Deaths in England and Wales, 1934

PART I, consisting of Tables (Medical), of the Registrar-General's Statistical Review of 1934 has just been published (London: H.M. Stationery Office. 6*s*. net). The number of live births in England and Wales registered in the year was 597,642, giving a birth-rate of 14·8 per 1,000 persons living. This rate was 0·4 above that for 1933, which was the lowest ever recorded. The death-rate was 11·8 per 1,000 persons living, 0·5 below the rate for 1933. When allowance is made for the fact that the average age of the living population is increasing every year, the resulting corrected or standardised death-rate was the lowest ever recorded both for men and for women, the rate for the sexes together being just half of the corresponding rate in 1881–90. Mortality from infectious and parasitic diseases in general reached a low record of 1·3 per 1,000, notwithstanding increases for scarlet fever and diphtheria, and the tuberculosis rate declined once again to a new low record of 763 per million. Pneumonia gave the lowest rate save in 1930, which was also a very healthy year. The

cancer rate, corrected for the increasing age of the population, rose slightly to 1,003 per million, but was still below the levels reached in 1928 and 1929. A new feature of the review is the tabulation of a 'comparability factor' for each separate town and rural district, which shows at a glance whether the distribution of persons by age and sex in the population of that area would lead to the expectation of a death rate above or below that of the country as a whole, and makes it possible to correct the death rate by a simple multiplication for valid comparison with that of any other area similarly corrected. After correcting in this way, the administrative County of London and the south eastern counties of Kent, Surrey, Sussex, Hampshire, Isle of Wight and Berkshire gave a combined mortality rate after correction only 84 per cent of that of the country as a whole, compared with 113 per cent for the north of England, namely, Durham, Northumberland, Cumberland, Westmorland, Yorkshire, Lancashire and Cheshire.

Archæological Investigation under the Soviets

ARCHÆOLOGICAL activities in Russian territory, in which the work of the Historical Museum of Moscow has been reinforced by the co-operation, financial and other, of museum authorities in the United States, have produced results of no little historical importance. Archæologists on the staffs of the various Russian museums are now engaged, according to a report from the Moscow correspondent of the *Observer* in the issue of October 27, in examining material brought in by expeditions to the Crimea, Kazakstan in Central Asia, the Georgian Republic in the Caucasus and the Ural Province. From the Crimea comes further evidence relating to Neanderthal man in the form of stone implements from a settlement site—not a cave—on the Katcha River, while in the neighbouring village of Pychka rock-paintings in red, depicting battle scenes, were discovered, which are attributed to a pre-Scythic culture of the third millennium B.C. The expedition of the Historical Museum to Kazakstan was occupied in excavating a site of the Bronze Age, on which a communal hut, measuring twenty-five metres in length, has been uncovered, as well as an altar about which were the charred bones of domestic animals, vessels containing the remains of food and bone cubes, which are said to resemble modern dice. In the Caucasus, cave deposits were examined, which yielded a number of flint implements of the palæolithic age.

Illuminating Engineering

IN his presidential address to the Illuminating Engineering Society, delivered on October 8, Mr. A. W. Beuttell took an optimistic view of the future of illuminating engineering. He based his claim on the inevitable demand for more artificial light which must approximate more and more to daylight. At the moment, the cost of this light is prohibitive, and the problem is to produce more light whilst using no more energy. The keeping low of energy costs will increase the cost of equipment. It is now realised that having incandescent metals near their melting point does not give the solution. On the other hand, vapour discharge lamps, although we are only at the threshold of these fields of discovery, whilst giving cheaper light, do not give white light. The question is now being thoroughly explored. The disturbance of electrons causing light is produced by heat, but at present much energy is lost in the non-visible spectrum. This problem is of great importance owing to the future great demand for light and the well-defined field with which we have to deal, and the fact that the production of light is based on the fundamental principles which physicists study. In considering the production and use of light, the psychological aspect has also to be considered. Mr. Beuttell expressed the view that in both the physiological and psychological processes concerning light, cause and effect hold good. Whilst we are learning rapidly, it is necessary that specialists should pool their knowledge.

The Internal Combustion Engine and its Fuel

ON OCTOBER 9, Mr. H. R. Ricardo received the Melchett Medal of the Institute of Fuel, and after the presentation delivered his Melchett Lecture on the "Progress of the Internal Combustion Engine and its Fuel". This progress he characterised as one of the most startling developments of the last fifty years, and now, he said, more than eighty per cent of the total power output of prime movers is based on petrol. He traced the development of the views held on the cause and character of the phenomenon of 'engine knock' and the formulation of the well-known method of evaluating 'knock-tendency' by means of the variable compression engine. The value of aromatic hydrocarbons was established by this machine and later the practice of rating fuel by an 'octane-number'. The production of fuels with high 'octane-numbers' has permitted the use of higher compression ratios with consequent greater engine efficiency, culminating in the 60 horse-power per litre attained by the Schneider engines. Further increase in the octane-number of petrols is not anticipated, nor the use of supercharging in pleasure cars. The Diesel engine is displacing the petrol engine in heavy commercial vehicles, and will continue to do so even at the same cost of fuel per gallon, owing to the 70 per cent advantage in the figure of miles per gallon.

The King's Fund Miniature Hospital

IN order to make known more widely the great work of the voluntary hospitals, Mr. Saxe Wyndham in 1929 suggested to the King Edward's Hospital Fund for London that a model of a modern hospital, complete in its smallest details, would be likely to arouse the interest of the public and so help the King's Fund. The Propaganda Committee of the Fund decided to undertake this work, and a design for the model was commenced by the late Mr. Percy Adams, and completed after his death by Mr. Lionel Pearson. At first, there was some difficulty in obtaining the necessary funds, but eventually Messrs.

Humphreys, Ltd., of Knightsbridge, generously undertook the responsibility, and a number of other firms collaborated in the construction and equipment. The model is to a scale of one sixteenth of full size, and includes adults' and children's wards, complete with bathrooms, lavatories and sink rooms, and with circular solarium at the end, operating theatres, X-ray apparatus, staircases and working electric lift, board room and kitchen, balconies and garden, together with figures of doctors, nurses and patients. The work was executed by a staff of skilled craftsmen, and so far as possible every detail essential to a building of this kind has been reproduced in the model—furniture, bedding, screens, radiators and others too numerous to mention. The model is on view until further notice at British Industries House, Hereford House, Oxford Street, London.

Agricultural and Horticultural Research

THE year 1934, coming after a period of monetary anxiety, brought financial stability to the National Fruit and Cider Institute and Research Station at Long Ashton, Bristol. This gratifying state of affairs has allowed the completion, or further prosecution, of several important pieces of investigational work. Some results of these are published in the annual report of the Station for 1934 (Long Ashton, pp. 312, July 1935). A foreword by Prof. B. T. P. Barker, the director, outlines the administrative changes of the organisation, and also of the Berkeley Square Advisory Centre, Bristol. The principal contributions of research results are three papers on the maturity of fruit by Dr. J. C. Hinton (NATURE, Oct. 26, p. 687), whilst numerous studies of pests and plant pathology have been prosecuted. The cider investigations include a consideration of the suitability of various containers for apple juice, the role of pectin in cider-making, experiments on clarification of the juice, and preservation with sulphur dioxide. A soil survey of the Teart Land areas of Somerset is also being made.

Television in Australia

BAIRD TELEVISION, LTD. announces that as the result of negotiations with the Australian Radio Manufacturers' Patents Association, Ltd., of Sydney, the Association has been appointed the exclusive representatives in Australia of the Baird Company, both for the construction and operation of television transmitting stations and the manufacture of television receivers under the Baird patents. The Australian Radio Manufacturers' Patents Association, Ltd. is composed of a majority of the leading radio manufacturers throughout the Commonwealth of Australia, and they propose to develop television as an adjunct to sound broadcasting. Experimental transmitters will, it is expected, be erected in Sydney and Melbourne in the near future, with the view of providing ultimately a commercial high-definition television service.

Louis Lumière Celebrations

A MEETING to celebrate the fortieth anniversary of the invention of the *cinematographe* by Louis and Auguste Lumière will be held in the Hall of the Sorbonne, Paris, on November 6 at 9 p.m. The meeting will be held under the presidency of M. Mario Roustan, Minister of Education; and M. Albert Lebrun, President of the Republic, will be present. Among the discourses will be one given by Prof. C. Fabry, professor of physics in the Sorbonne and president of the French Society of Photography and Cinematography. During the celebrations, certain films made in 1894, and colour photographs of 1907–1935, will be exhibited. Further information can be obtained from the Secrétaire Général, 11 Avenue Casimir, Asnières (Seine).

Awards of the Institution of Civil Engineers

THE following awards of the Institution of Civil Engineers have recently been made for papers read and discussed at ordinary meetings: a Telford Gold Medal to B. M. Hellstrom (London); a Telford Premium jointly to F. W. D. Davis (London) and William Mackenzie (Hull); a Telford Premium to G. L. Groves (London); a Telford Premium jointly to C. Seager Berry (Baldock) and A. C. Dean (Manchester); a Telford Premium to E. J. Buckton (London); a Telford Premium to W. J. H. Rennie (Singapore); a Telford Premium and the Coopers Hill War Memorial Prize to A. W. H. Dean (New Delhi); a Telford Premium and the Indian Premium to M. G. Platts (Madras); a Telford Premium jointly to J. A. K. Hamilton (Cleveland, York) and J. Tudor Graves (Middlesbrough); a Telford Premium to Alexander Gray (St. John, Canada); a Trevithick Premium to George McIldowie (Newcastle, Co. Down); a Trevithick Premium jointly to W. T. W. Miller (Sheffield) and R. J. Sargant (Sheffield); a Manby Premium to M. A. Ravenor (London); a Crampton Prize jointly to V. F. Bartlett (London) and W. H. Cadwell (Mellor, Derbyshire). For papers published without discussion as 'Selected Engineering Papers': a Telford Premium to T. H. Hopkins (Bromley, Kent); a Telford Premium jointly to Prof. E. G. Coker (London) and G. P. Coleman (London); a Telford Premium to Ralph Poole (Bradbury, Cheshire); a Telford Premium to W. H. Weston (Glasgow); a Telford Premium to C. G. Watson (London). For papers read at students' meetings: the James Forrest Medal and a Miller Prize to James Halliday (Dunbar); Miller Prizes to R. S. Cogdon (Sunderland), Geoffrey Wood (London), R. G. Rowbotham (Buenos Aires), G. R. Coles (St. Albans, Herts) and J. L. Matheson (Stafford). The Charles Hawksley Prize has been awarded to Frank W. Curry (London).

Announcements

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 28 the following council was elected: *President:* Prof. D'Arcy Wentworth Thompson; *Vice-Presidents:* Prof. C. G. Darwin, Prof. R. A. Sampson, Principal O. Charnock Bradley, Prof. P. T. Herring, the Marquis of Linlithgow and Prof. E. B. Bailey; *General Secretary:* Prof. J. H. Ashworth; *Secretaries to Ordinary*

Meetings: Prof. F. A. E. Crew and Prof. J. P. Kendall; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Dr. L. Dobbin; *Councillors:* Lieut.-Col. A. G. M'Kendrick, Prof. James MacKinnon, Prof. W. Peddie, Dr. A. C. Aitken, Principal J. C. Smail, Sir Harold J. Stiles, Prof. J. Walton, Prof. Edwin Bramwell, Prof. T. H. Bryce, Prof. I. de Burgh Daly, J. A. Inglis and Prof. A. D. Peacock.

THE council of the Royal Society of Edinburgh has made the first award of the David Anderson-Berry Prize to Dr. C. M. Scott, lecturer in materia medica in the University of Edinburgh, for his essay "On the Action of X- and Gamma-Rays on Living Cells". This prize, which consists of a gold medal and a sum of money, was founded by the late Dr. David Anderson-Berry in 1930, and is awarded triennially to the person who, in the opinion of the council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases.

THE first evening meeting of the 1935–36 series to be held in the house of the Pharmaceutical Society of Great Britain, on November 12, will be the occasion of the presentation of the Harrison Memorial Medal to Prof. Arthur Smithells, director of the Salters' Institute of Industrial Chemistry, who will deliver the Harrison Memorial Lecture. The title of the lecture is "The Teaching of Chemistry". Prof. Smithells was chief chemical adviser (Anti-Gas Training) G.H.Q. Home Forces 1916–19 and was closely associated with the late Colonel E. F. Harrison, director of Chemical Warfare, in anti-gas work.

DR. BERNARD SMITH will deliver the Cantor Lectures of the Royal Society of Arts on November 18 and 25, and December 2, at 8 p.m. The subject of Dr. Smith's lectures will be "Geological Aspects of Underground Water Supplies".

DR. HERBERT DINGLE, assistant professor of astrophysics in the Imperial College of Science, South Kensington, is giving a course of ten Lowell Institute Lectures at Boston, Mass., beginning January 3. Dr. Dingle's subject will be "Through Science to Philosophy".

DR. W. H. MILLS, the Right Hon. Lord Riverdale, Prof. A. Robertson, and Mr. H. B. Shackleton have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. E. J. Butler, Sir Kenneth Lee, and Prof. N. V. Sidgwick have retired from the Council on the completion of their terms of office.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 p.m. on November 7, Lieut.-Col. K. Edgcumbe will, on behalf of Colonel R. E. Crompton, Faraday medallist, honorary member and past-president, present to the Institution an oil painting of Colonel Crompton by Mr. George Harcourt. The painting was subscribed for and presented to Colonel Crompton by a group of 'Old Cromptonians' and other admirers on the occasion of his ninetieth birthday; but, at his express desire, it is now to become the property of the Institution.

THE Rockefeller Foundation has recently awarded 14,000 dollars to the University of Michigan for the application of spectroscopic methods in medicine.

FOR many years the late Mr. Archibald Thorburn (see p. 710 of this issue) has presented the Royal Society for the Protection of Birds with a painting for the illustration of its annual greetings-card. The subject for Christmas 1935 is the goldcrest, the smallest of all British birds, alighted on a twig of oak. Copies may be obtained from the Royal Society for the Protection of Birds, 82 Victoria Street, London, S.W.1, price 4*s*. 8*d*. a dozen, inclusive of envelopes and postage. All proceeds from the sale of the cards are devoted to the funds of the Society.

MESSRS. CHAPMAN AND HALL, LTD. announce that they have been appointed sole British Empire agents for the publications of the Reinhold Publishing Corporation, which is the successor to the Chemical Catalog Company, Inc. In addition to numerous well-known scientific and technical books, the Reinhold Publishing Corporation controls the issue of volumes appearing under the auspices of the American Chemical Society. This scheme of publication was undertaken by arrangement with the Interallied Conference of Pure and Applied Chemistry, which met in London and Brussels in July 1919, when the American Chemical Society and the National Research Council mutually agreed to care for certain fields of chemical development. A complete catalogue (150 titles) is now available and can be obtained from Messrs. Chapman and Hall, Ltd., 11 Henrietta Street, London, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Assistants in the Departments of Mechanical Engineering, Electrical Engineering and Physics, and Mathematics of the Coventry Technical College—The Director of Education, Council House, Coventry (Nov. 8).

A principal of Aston Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham, 3 (Nov. 11).

A professional assistant at the Royal Observatory, Hong-Kong—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (Nov. 23).

An inspector of mines and petroleum technologist for service in Trinidad and Tobago—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (Nov. 30).

A librarian at the Institution of Automobile Engineering—The Director, 5 Bolton Road, Chiswick, W.4.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 723.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Helium Content of the Stratosphere

IT is often assumed that the absence of any systematic temperature gradient in the stratosphere is incompatible with large-scale mixing; winds, which in the troposphere ensure a constant composition of the permanent atmospheric constituents, are supposed to fall off rapidly as the boundary between the troposphere and stratosphere is passed, and above the level at which mixing ceases the composition of the atmosphere should therefore vary with the height. Over England, the boundary between troposphere and stratosphere lies between 10 km. and 11 km.; so far, however, we do not know where the large-scale mixing in the stratosphere becomes negligible. Chapman and Milne[1], therefore, in their well-known tables, provide for four cases in which effective mixing ceases and diffusion commences, at heights of 12 km., 20 km., 30 km., and 50 km. respectively. Maris[2] has suggested that effective mixing takes place up to about 100 km.

The most direct method of finding the level where diffusive separation actually begins is the chemical analysis of air samples; up to this height the composition must necessarily be the same as at the surface of the earth; above this level the lighter constituents of the air should be present in higher percentage. The lightest gas, hydrogen, would be the ideal indicator, but its proportion in air is so low that there is at present no method of sufficient sensitivity available. The gas which, owing to its lightness, is next best suited is helium, which has the additional advantage that no complication due to chemical reactions are to be feared. From the calculations of Chapman and Milne, it follows that the amount of helium should increase by 1 per cent in the first 75 metres of the undisturbed layer of the stratosphere.

Oxygen as an indicator is eight times less sensitive. Of the air samples brought back from an altitude of nearly 19 km. over Russia by the stratosphere flight of Prokoflev, Godunov and Birnbaum on September 30, 1933, only the oxygen content has been analysed separately; it showed no deviation[3]. The same result was found by Lepape and Colange[4], so far as the main constituents of the atmosphere are concerned; in nine samples of air, taken between 9·0 km. and 16·8 km., the content of oxygen, of nitrogen and of argon + neon + helium, was identical with that at the level of the earth. The proportion of helium + neon to the total of rare gases, however, was found on the average to be 27 per cent higher than at the surface, a result which the authors apparently regard as real, and not due to the inaccuracy of their method; this would mean a still greater change in the percentage of helium alone, without neon.

We decided to investigate the problem of the mixing of the stratosphere by measuring directly its helium content. With the co-operation of Sir George Simpson, director of the Meteorological Office, several sounding balloons have been sent up by the Upper Air Section of Kew Observatory and samples of the air obtained. Much greater heights can be reached in this way than in manned stratosphere flights. To reach high altitudes by such balloons, it is essential to keep the weight as low as possible, a fact which made it imperative to develop a method for finding the helium content in small samples of air with high accuracy. We can now separate the helium of a few cubic centimetres of air from all other constituents; the amount of helium so obtained is measured by a procedure described in previous publications on the micro-analysis of helium[5]. Details of the method, which enables us to determine the helium content of 2 c.c. of air with an accuracy of 1 per cent, will be published elsewhere.

For the automatic sampling, a device was used which comes into operation after the sounding balloon, at the top of its flight, has burst; an extension of an evacuated glass bulb is then broken, and while the vessel, attached to a parachute, begins to fall, air is sucked in; after an interval of 10–15 sec. the extension is sealed again. If the mechanism functions satisfactorily, the pressure of the air inside the vessel should correspond within certain limits to the highest value of the barographic record. In the following table the figures in each row are derived from one sample of air; at least three portions of each sample have been separately analysed with accordant results.

Helium content of the atmosphere at different heights over England.

Height in km. (Dines baro-thermograph)	Height in km., as measured by pressure inside vessel	Helium in 10^{-6} c.c. per c.c.	Helium surplus, compared with London air (per cent)
—	0	5·27 ± 0·05	
16·8	14·0	5·35 ± 0·07	1·7 ± 1·4
18·5	18·4	5·31 ± 0·05	0·7 ± 1·0
21·0	20·4	5·69 ± 0·06	8·0 ± 1·0

From our analyses, it seems to follow that, up to 18 km., we are not yet above the ideal boundary considered by Chapman and Milne, where mixing ceases and diffusion becomes effective; this is in good agreement with the results of the Russian explorers. At a height of 21 km., however, the helium content is already distinctly increased. So far, nothing definite is known about its constancy in different parts of the earth's surface, and the first analyses of a survey begun by us indicate that local variations actually occur. The value found for London, however, agrees within 0·3 per cent with the average of analyses from eight different places in Germany, Sweden, the United States, Central America, and over the Atlantic, and the 8 per cent helium surplus in the air from 21 km. height appears to be outside the range of these variations; but more samples are needed before it will be clear whether the helium found is characteristic for this height.

We hope to apply our method of analysis to samples from still higher levels of the stratosphere. We are continuing our own experiments with sounding balloons, but as for this purpose England is neither geographically nor climatically very favourable, we should welcome the co-operation of others interested in stratosphere research. Air samples of volume about 6 c.c. (N.T.P.) would permit us to carry out three independent analyses of the helium content.

In conclusion, we would express our gratitude to Sir George Simpson, director of the Meteorological Office, London, for the assistance he has given us in arranging for the collection of samples of air from the stratosphere.

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E. GLÜCKAUF.

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Oct. 15.

[1] S. Chapman and E. A. Milne, *J. Roy. Meteor. Soc.*, 46, 357; 1920.
[2] H. B. Maris, *Terr. Mag.*, 33, 238; 1928.
[3] NATURE, 133, 918; 1934.
[4] A. Lepape and G. Colange, *C. R.*, 200, 1840, 1871; 1935.
[5] F. A. Paneth and K. Peters, *Z. phys. Chem.*, 134, 353; 1928.
F. A. Paneth and Wm. D. Urry, *Z. phys. Chem.*, A, 152, 100; 1931.

Vertical Intensity of Cosmic Rays by Threefold Coincidences in the Stratosphere

A YEAR ago we communicated the results of an ascent with a Geiger-Muller tube counter by registering balloons into the stratosphere to a height of 28 km.[1]. We found that the curve of the number of impulses obtained with the counter is identically the same as the intensity curve obtained with an ionisation chamber.

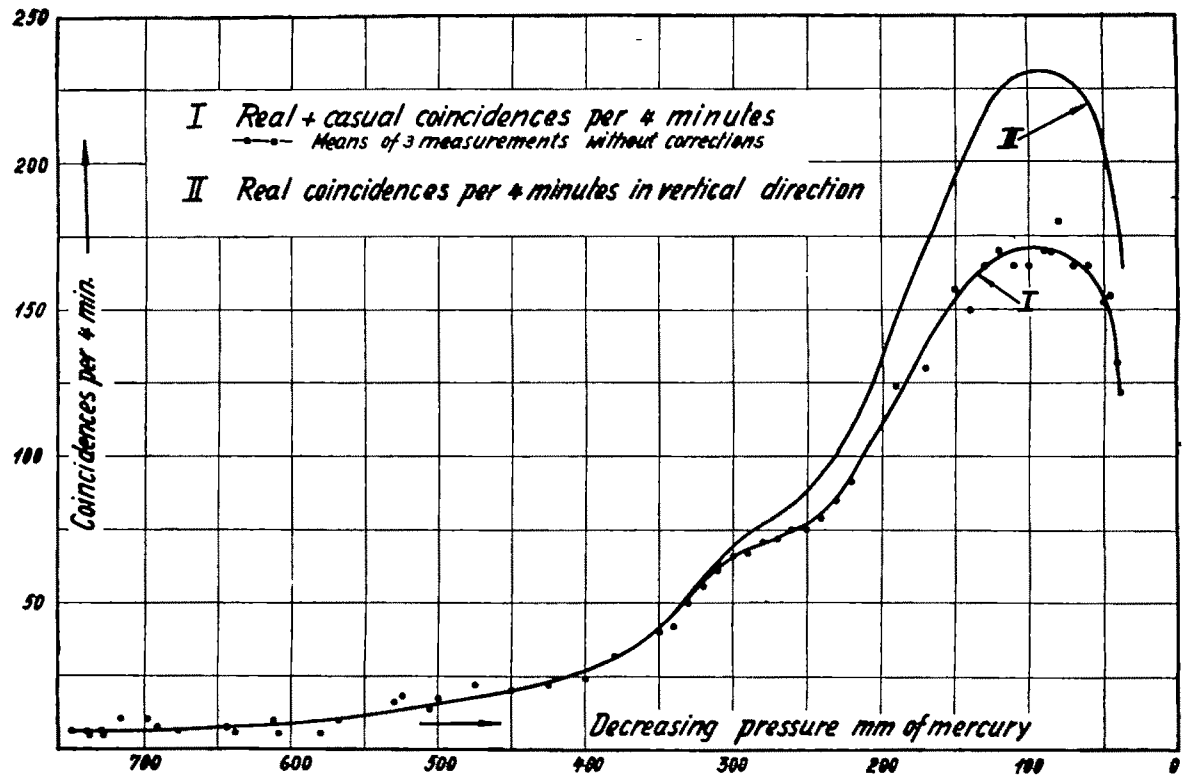
Recently, we succeeded in sending up a *threefold*-coincidence apparatus by balloons to a height of 22 km. (37·5 mm. mercury). The three counters had been arranged one above the other in such a manner that the area, 45 mm. × 50 mm., of the outer counters subtended a solid angle of only 20° about the zenith. Therefore, only the nearly vertical rays producing coincidences are recorded.

The data for pressure, temperature and counting rate were recorded every four minutes in the same way as previously described on a photographic plate[1]. The coincidence arrangement gave a high resolving power even at a high counting rate of a single counter. The apparatus was protected against the low air temperature by a case of 'cellophane'[2]. The temperature in the case varied only between + 25° C. and + 17° C. Therefore there was no influence of temperature on the recorded data.

Curve I (Fig. 1) shows the means of the results from two ascents and one descent. This curve requires correction according to the known probability of coincidence counting and of casual coincidences. Curve II shows the values thus reduced. There is to be seen a maximum at a pressure of 100 mm. of mercury and a well-marked hump at a pressure of 300 mm. The humps are obviously to be attributed to the components of the cosmic rays of primary or of secondary origin. It is remarkable that the same humps appear in the curve earlier found with one counter, if we transform the earlier curve indicating impulses from all directions to that showing impulses in the vertical direction by the method of B. Gross[3].

The curve tends to zero with decreasing pressure. But because of the latitude effect, it is not probable that the continuation of the curve will really pass through the zero. On the contrary, it is to be expected

FIG. 1.



that further ascents to greater heights will give a definite intensity of coincidence-producing rays near the top of the atmosphere.

A more detailed report will be published in the special number of the *Zeitschrift für technische Physik* for the Physikertagung, 1935.

We wish to thank the Deutsche Forschungsgemeinschaft for providing the means enabling us to make these investigations.

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GEORG PFOTZER.

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Technische Hochschule,
Stuttgart.

[1] E. Regener and G. Pfotzer, NATURE, **134**, 325; 1934. *Phys. Z.*, **35**, 779; 1934.
[2] E. Regener, NATURE, **133**, 364; 1933. *Phys. Z.*, **34**, 306; 1933.
[3] B. Gross, *Z. Phys.*, **83**, 214; 1933.

Radioactivity of Samarium

SEVERAL workers have investigated the radioactivity of samarium, and it is established that this element emits short-range α-particles. Mäder[1] has also reported the existence of a group of particles of range 1·37 cm., which he believes to be protons. To obtain fuller information about these particles, I have introduced samarium sulphate into the emulsion of an Ilford '*R*' plate, and examined the tracks which are produced. The technique of this method has been previously described[2].

After seven weeks exposure, numerous tracks are observed on the plate, most of which clearly belong to the short-range α-particle group. The accuracy with which the range in air can be determined from measurements of the length of the tracks is now known, and an account of the method used in making this determination will shortly be published. The range so determined is

$$R = 1{\cdot}13 \pm 0{\cdot}02 \text{ cm. standard air.}$$

This value is in good agreement with those previously published.

In addition to these short tracks, we have observed tracks which correspond to particles of much longer range, up to at least 3·5 cm. air. These are much less numerous than the short tracks, the relative frequency being of the order 1 : 100. So far, some 150 such tracks have been measured. The distribution curve of the measurements does not show any well-defined maximum, such as is always found with a group of α-particle tracks, and the 'scatter' of the measurements is much greater than is found, for example, with the tracks of uranium α-particles, for which numerous measurements have been made. This alone is strong evidence that we are not dealing with a group of α-particles. Furthermore, the mean separation of the grains is found to be 2·0μ for the whole group, and many of the individual tracks show greater values. The mean separation for the short-range α-particle tracks, obtained on the same plate, is 1·6μ. It has been pointed out previously[2] that this forms a criterion for distinguishing between α-particle tracks and proton tracks. It appears, therefore, that the long tracks cannot be attributed to α-particles, and we must conclude that samarium emits singly-charged particles.

It is not yet possible to make any accurate statement as to the range of these particles. The distribution curve suggests that more than one group may be present, but the greatest range must be in the neighbourhood of 3·5 cm. air. It is hoped that further observations will make it possible to decide these points.

I am indebted to Prof. Hevesy for supplying a specially pure sample of samarium, and to Mr. Dabholkar of this Department for help in the measurements.

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Sept. 13.

[1] Mäder, *Z. Phys.*, **88**, 601; 1934.
[2] Taylor, *Proc. Roy. Soc.*, A, **150**, 382; June 1935.

Emission of Positrons from Radioactive Sources

WITH the improved apparatus, already used by us in the investigation of positrons from thorium-active deposit, we have repeated our measurements of the positron spectrum, emitted by a thin-walled radon tube; a new determination of the ratio of the positron number to that of the β-particles of RaC was also made. The positron spectrum is shown in Fig. 1: for each point about 1,000 particles were counted. The ratio N_+/N_β was found to be $2\text{–}3 \times 10^{-4}$ (N_+ = number of positrons, N_β = number of β-particles of RaC). Surrounding the source with a 1 mm. lead sheet, we could compare the number of positrons emitted by the source with that produced by the γ-rays of RaC in lead: it was found that $N_+/N_+(\text{Pb}) = 0{\cdot}9\text{–}1$.

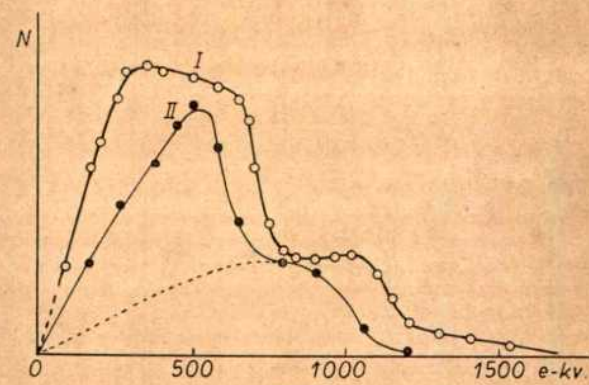

FIG. 1.

In the positron spectrum from the source, two discontinuities are observed at 760 and 1,200 e.kv., which correspond to the internal conversion of two strong γ-rays of RaC with energies 1,760 and 2,220 e.kv. The general shape of the spectrum does not correspond, however, either to the theoretical spectrum of internal conversion of γ-rays from RaC, or to the positron spectrum, produced in the thin (25μ) lead foil by γ-rays (curve II). By a method similar to that used in ouranalys is of the positron spectrum from thorium[1], it is possible to separate the portion of the spectrum due to the internal conversion of γ-rays from the total spectrum. The remaining main portion of the spectrum has the features of a continuous spectrum extending in energy up to 1,700 e.kv. The number of positrons belonging to this portion of the spectrum is of the same order of magnitude as that in the spectrum of

thorium-active deposit, that is, about 1–1·5 per 10^4 β-particles of RaC, and exceeds the number of positrons due to the internal conversion of the γ-lines 1,760 and 2,220 e.kv. by a factor of about 2.

Placing aluminium plates 0·5 mm., 1 mm. and 3 mm. thick in front of the source, we tried to reveal positrons produced by β-particles from RaC in traversing the aluminium. According to D. Skobelzyn and E. Stepanowa[2], these positrons greatly exceed (50–70 times) in number those originated by the action of γ-rays in the same substance. Our measurements showed a small difference in the positron number when passing over from the thin (0·5 mm.) to the thick (3 mm.) plate; this effect arising from the partial transmission of the positrons from the source through the thinner plate.

Having placed in our apparatus a strong radon source so that positrons of the source could not reach the counters, we irradiated by γ- and β-rays and also by γ-rays only a 25μ-thick lead foil. In this experiment the positrons going from the lead strip to the slit of the apparatus made an angle of 90° with the direction of β-particles and γ-rays. The number and the spectrum (II, Fig. 1) of positrons observed indicate clearly that most of the positrons are produced by γ-rays of RaC. Thus we are led to the conclusion that the cross-section for the production of pairs by γ-rays of RaC is at least several times greater than the cross-section for β-particles of RaC; as in the case of lead, so in that of aluminium.

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M. S. KOSODAEW.

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Leningrad.
Sept. 22.

[1] A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew, NATURE, **136**, 475, Sept. 21, 1935.
[2] D. Skobelzyn and E. Stepanowa, *J. Phys.*, **6**, 1; 1935.

'Extra' Rings in Electron Diffraction Patterns

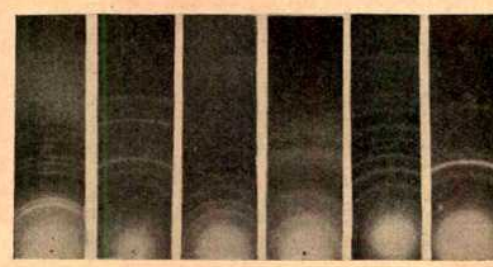
MARK, Motz and Trillat[1] have shown that traces of grease can give rise to 'extra' rings in electron diffraction patterns from metal films. In agreement with them, we have found that the spacings of these grease rings are as given in col. 1 of the accompanying table, and are independent of the nature of the metal substrate. The spacings of 'extra' rings obtained by

'Extra' Ring Spacings in Angström Units

1	2	3	4	5	6
4·02	4·81	3·85	4·49	3·75	4·93
3·62	4·00	3·46	2·57	2·93	4·09
2·90	2·79	2·81	1·69	2·44	3·37
2·43	1·83	2·45	1·50	1·81	3·24
2·30	1·61	2·31		1·57	2·85
2·17	1·49	2·15			2·57
2·01		2·05			1·70
1·92		1·83			
1·81		1·62			
1·71		1·49			
1·58		1·40			
1·47		1·29			

heating a metal in a gas are, however, quite different in that they depend not only upon the metal but also upon the gas and the nature of the heat treatment[2]. Thus, for example, we have obtained different 'extra' ring systems by drawing gold leaf through a Bunsen flame (col. 2) and by heating in oxygen at 540° C. during 30 minutes (col. 3). The reproductions 1–6 are from the corresponding electron diffraction patterns.

We have also found that amalgamation gives rise to 'extra' ring systems which, like those due to absorbed gases, have spacings dependent upon the metal. The spacings found for some gold, silver and copper amalgams, and given in cols. 4, 5 and 6 respectively, are quite different from those due to either grease or absorbed gases. The gold and silver amalgams were prepared by suspending the metal leaf in the vapour above a warmed drop of mercury until signs of amalgamation were visible at the lower edge of the leaf. Copper amalgam was obtained by immersion in a mercuric chloride solution.



1 2 3 4 5 6

In studying the absorption of gases by metals, it is therefore important to exclude the formation of 'extra' rings due to grease or amalgamation; whilst the former should, for the reasons given above, always be easy to recognise, the amalgam 'extra' rings appear to have much in common with absorbed gas 'extra' rings, at least in so far as the spacings of both vary from metal to metal.

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A. G. QUARRELL.

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South Kensington,
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Oct. 16.

[1] *Naturwiss.*, **20**, 319; 1935.
[2] *Trans. Far. Soc.*, **31**, 1051; 1935.

Structure of Solid Oxygen

As is well known, solid oxygen appears in three modifications: α (below 23·5° K.); β (23·5°–43·5° K.); and γ (43·5° K. and melting point). In connexion with our investigations on the structure of solidified nitrogen and other gases, extensive work has been done with the object of determining the structure of the various forms of solid oxygen.

Already in 1927, McLennan and Wilhelm[1] published a powder diagram of α-oxygen which they tried to interpret by means of a rhombic cell. We found, however, that their interpretation could not account for the intensity distribution of the spectrum. Later on, powder diagrams of α- and β-oxygen were given by Ruhemann[2]. The two forms gave similar diagrams, which he tried to interpret by means of the rhombic cell proposed by McLennan; the result was not satisfactory.

In 1929 and following years, we obtained powder diagrams of β-oxygen, showing a large number of lines, but we found that the rhombic cell of McLennan could not account for the lines appearing in our diagrams. They were, however, satisfactorily interpreted by means of a trigonal (rhombohedral) cell, containing six molecules ($a = 6·19$ A., $\alpha = 99·1°$) corresponding to a density $\rho = 1·395$.

In spite of considerable efforts, we have not yet been able to determine the arrangement of the molecules within the cell; but I think we can say safely that only the space groups C_{3i}^2, C_{3v}^5 or D_3^7 can come into consideration.

We have also been able to obtain quite good powder diagrams of γ-oxygen. The spectrum shows those features which are typical for a lattice with rotating molecules. The diagrams were interpreted by a *cubic* cell ($a = 6 \cdot 83$ A.) containing 8 molecules, corresponding to a density of $\rho = 1 \cdot 30$. In this case we have also been able to find the arrangement of molecules within the cell which satisfies the intensity distribution.

The lattice belongs to the space group T_h^6. The position of the individual atoms are not fixed by this space group, but only the molecular centres. The molecules rotate in the lattice, and they are grouped into pairs along the trigonal axis. The distance between the two molecules of a pair (3·48 A.) is somewhat smaller than the minimum distance (3·68 A.) between neighbouring pairs. This indicates that the molecules of the pair are tied up with stronger forces than molecules of different pairs.

The study of the absorption bands of liquid oxygen by Ellis and Kneser[3] also indicates the existence of groups (O_2–O_2). This tendency to form groups explains the fact that γ-oxygen, although it possesses rotating molecules, does not appear in a closest spherical packing of molecules, as in the case of β-nitrogen. The centres of the pairs (O_2–O_2), however, form a face centred lattice, and we may, therefore, say *that γ-oxygen forms a closest cubical packing of pairs of oxygen molecules.*

γ-Oxygen may also be regarded as belonging to the space group T^4. In this case we arrange the molecules in two fourfold equivalent positions with parameters x_1 and x_2. Putting $x_1 = -x_2$, the symmetry of the lattice is raised to that of the space group T_h^6.

As shown in previous papers also, the lattices of α-N_2 and α-CO approximately fulfil these conditions, and they are therefore closely related to that of γ-oxygen.

The lattice of γ-oxygen is obtained when in α-nitrogen or in α-CO each atom is replaced by a rotating oxygen molecule (O_2), and the parameters are subject to the relation $x_1 = -x_2$.

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Sept. 30.

[1] *Phil. Mag.*, (7), **3**, 383; 1927.
[2] *Z. Phys.*, **76**, 368; 1932.
[3] *Z. Phys.*, **86**, 583; 1933.

Cinematographic Record of the α⇄γ Iron Transition, as seen by the Electron-Microscope

RECENTLY E. Brüche and W. Knecht[1] described the electronoptical observation of the transition of α- into γ-iron. In their beautiful experiments, however, the emission of the test-piece (after activation by means of an evaporated barium layer) at the transition temperature of about 900° C. was so small that the actual occurrence of the process could not be observed on the fluorescent screen without sufficient adaptation of the eye. In order to obtain a fluorescent image clear enough to be photographed, the temperature of the test-piece had to be raised to about 1000° C. A photographic record of the transition could therefore only be obtained by observing whether, after lowering the temperature to the neighbourhood of the transition point and raising it again at 1000°, the texture of the test-piece had changed or not.

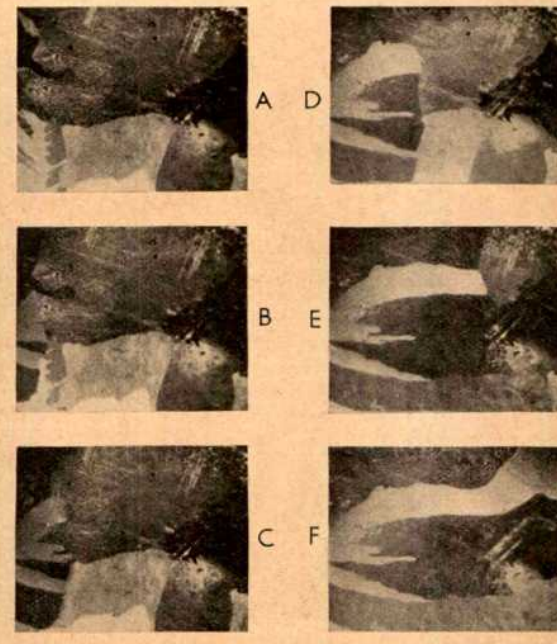

FIG. 1. Growth of α-iron crystals in the original γ-phase.

Using an 'electron-microscope' with one magnetic lens, similar to that described by other authors[2], we succeeded in obtaining even below 900° C. an intensive emission from a strip of iron after careful activating by means of evaporated barium or strontium oxide, so that the fluorescent image could easily be photographed with a film camera (N.A. 1 : 2·7; $f = 4$ cm.) after an exposure of 1–2 sec. Since by slowly lowering or raising the temperature through the transition point the growth of the new crystals could be made to take place in 5–10 minutes, it was thus possible to obtain a cinematographic record of the transition process (a photograph was taken every 4 seconds). In Fig. 1, *A–F*, six separate photographs have been reproduced. They show clearly the growth of α-crystals (starting at the left) in the original γ-phase. It is of interest to remark that the progressive growth of the newly-formed crystals observed here is essentially different from the sudden formation of martensite needles in austenite, of which a cinematographic record by means of ordinary microphotography has been made by Wiester[3].

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Sept. 16.

[1] E. Brüche und W. Knecht, *Z. tech. Phys.*, **16**, 95; 1935. **15**, 461; 1934.
[2] M. Knoll, F. G. Houtermans und W. Schulze, *Z. Phys.*, **78**, 340; 1932. J. Pohl, *Z. tech. Phys.*, **15**, 579; 1934. See also E. Brüche, *Kolloidzeitschrift*, **69**, 389; 1934.
[3] H. J. Wiester, *Z. Metallk.*, **24**, 276; 1932. A similar cinematographic record of the α–γ-transition in iron and steel has also been obtained by H. Esser and H. Cornelius (*Stahl und Eisen*, **53**, 532; 1933).

Statistical Tests

I HOPE some space will be afforded me for comment on Prof. Karl Pearson's letters[1], since I fear that Prof. Pearson's expressed opinions are not calculated to engender trust in modern statistical methods. These have proved, however, to be of almost universal practical service in minimising the number of times an observer may be misled by his observations.

To commence with, I must answer Prof. Pearson's attack on the logical position of Prof. Fisher and myself. No doubt Prof. Fisher will have something to say on the matter. For myself, I would point out that I never assume that data are capable of proving either the truth or the untruth of a hypothetical cause of our observations. The hypotheses being tested by the data are the following: Do the data indicate that a stipulated hypothesis is not likely to be true; and the reverse hypothesis—do the data *not* indicate this? All statistical tests appear to me to be of this kind. If the data do not indicate—I am not using the word prove—that the stipulated hypothesis is false, the simplest explanation of the data is often that the hypothesis is true. This holds good especially in cases where the stipulated hypothesis is *known* to be a simple and a likely explanation of the data. Such cases are very numerous.

To attempt to cover all hypothetical frequency distributions under the term 'graduation formulæ' is to overlook the fact that, as used, such distributions are of two radically different kinds. The first kind contains those which may be *expected* to have given rise to our observations. Of this kind is the binomial distribution as used for testing bias in dice or throwing of dice. The 'limit' approximations, the normal distribution, Prof. Pearson's Type III, the Galton-Macalister, and the Poisson series, for example, may often be justified as 'expected' explanations; also the straight line, the parabola and the hyperbola and the aggregate of two or more samples. The manner in which they arise in theory may be assumed reasonably to resemble the manner in which they arise in practice in many cases. They are reasonable explanations of our data unless these themselves indicate that they are not. They are not mere graduation formulæ. Of the second kind are the distributions mentioned, together with a host of empirical distributions without simple theoretical basis, when they cannot *explain* the origin or cause of the data. These are truly mere graduation formulæ. They may be very useful as such but do not increase our knowledge of the work of Nature. Of such a kind is Makeham's formula. To use such formulæ to cover a combination of simple *explanations* of observations is to obscure the workings of Nature, not to elucidate them. Yet as mere graduation formulæ they may be ideal.

Prof. Fisher's school of statisticians aims at disentangling combined simple explanations of observations from each other and thus showing up likely *causes* of the data. It is true that in their work it is assumed generally that the observations or simple functions of them are samples from a normal population since the processes of analysis used are then more readily applied. It has been shown, however, that these processes of analysis are often fully justified where the fundamental assumption is not strictly justified, and that the methods are most valuable in minimising the number of times an observer may be misled by data. Mere graduation formulæ cannot ever perform this practical service.

My plea for the use of different levels of significance as criteria of judgment whether data do or do not indicate the unlikelihood of a given hypothesis has an analogy in engineering practice. I mean the use of the 'breaking strain' and the 'working load' of a given kind of rope. At strains near the breaking strain the rope is likely to break: at strains near the working load it is unlikely to break. At intermediate strains the likelihood of breaking cannot be expressed. With full knowledge the 'likelihood' could be expressed as a probability, but such full knowledge is not assumed. Reasonable safety is what is required. My aim is to make a safety-gap between "not shown to be an unreasonable explanation" and "may be considered a likely explanation". The notion does not apply to graduation formulæ, but only to expected causes. If no particular cause is expected it would appear safer to consider always that the sample exactly represents the form of the population. No other population is shown to be even *possible* by the sample itself. This does not preclude the use of a graduation formula to express concisely the general form of the sample and to provide parameter-distributions of very similar form to those applying to the sample-population.

H. J. BUCHANAN-WOLLASTON.

Fisheries Laboratory,
Lowestoft.
Oct. 8.

[1] NATURE, **136**, 296, 550, Aug. 24 and Oct. 5, 1935.

The Accessibility of Discoveries

WE are indebted to NATURE (**136**, p. 606) for an admirably sharp picture from Dr. Royds setting out his discovery (by its emission spectrum, which is in excess of its absorption as an atmosphere) of a layer of oxygen about a thousand miles deep at the base of the solar chromosphere. As he hints, his graph of intensities gives data for the law of distribution of oxygen-density with height: and he refers to a forthcoming *Kodaikanal Bulletin* for a discussion of this fundamental problem. But where is one to find it? When I was a member of the Indian Observatories Committee, the *Bulletin* came to me regularly, and was often of intense observational interest, which I sometimes exploited: but about twenty years ago my place on the Committee was vacated, and I have never seen a *Bulletin* since, nor do I know how to find one. Yet I am still favoured with personal copies of American and French astronomical reports. I am, moreover, by way of contrast, often overloaded with astronomical theory coming from the Royal Society and the Royal Astronomical Society, in the main too complicated analytically for my slow rate of appreciation, as an amateur no longer young. The brief accounts in *Science Abstracts* come therefore as a relief.

This note is presented mainly by way of illustration of current methods, especially in Government publications, against which I used to protest in vain when I had a seat in the House of Commons, of fixing prices on a scale that will recover the expense if all the copies of the edition are sold, regardless of the consideration that this price may prohibit the sale of any copies at all. And then what is the use?

JOSEPH LARMOR.

Holywood,
Co. Down.
Oct. 11.

Surface Structure Beneath the Pacific

IN *Science Abstracts*, *A*, July 25, 1935, No. 2944, which reached here yesterday, one reads that calculations by R. Stoneley from data for an earthquake in Mexico at Apia point to an upper layer of granitic material beneath the Pacific about 10 km. thick resting on ultrabasic rock.

A month ago I came here to relieve Mr. J. Wadsworth (director), on furlough, and have since interpreted records of a few minor shocks with origins less than 10° from Apia. I found, unexpectedly, that velocities given in Jeffreys' "The Earth" (second edition, par. 6–9, p. 116) very closely fit particularly the transverse waves, for upper, intermediate and lower layers, as for thicknesses cited therein. *P* phases are much fainter, but phases corresponding to longitudinal wave velocities appropriate to these three layers do seem to exist too, on some records studied so far.

Such layers exist in New Zealand, but publications read there created the impression that these layers may be absent near Samoa. My deductions, both in method used and as an attempt, have been quite independent of those by Stoneley. However, both results are favourable to a 10 km. granitic layer. References available here so far leave a doubt as to common agreement on the intermediate layer, because some writers call only the lower layer "ultrabasic". In my judgment, Wiechert records here are as clear on this point as are some published by Jeffreys cited earlier.

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Apia Observatory,
Western Samoa.
Sept. 3.

Microscope Technique

IT is proposed to bring out shortly a tenth edition of the "Microtomist's Vademecum". I shall be glad to hear from other laboratory workers of any new and special methods which would be suitable for inclusion in the new edition. Correspondence from North and South America should be forwarded to the American editor, Dr. Theophilus Painter, Department of Zoology, University of Texas, Austin, Texas, U.S.A.

J. BRONTÈ GATENBY.
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Oct. 15.

Points from Foregoing Letters

In order to find out at what height of the atmosphere large-scale mixing (winds) ceases to occur, Prof. F. A. Paneth and E. Gluckauf have determined the percentage of helium in samples of air obtained by means of sounding balloons sent up from Kew. Up to a height of 18 km., the percentage remains practically constant, but at 21 km. a noticeable increase (8 per cent) was observed. The authors ask the co-operation of stratosphere investigators in various parts of the world in order to obtain small samples of air from high altitudes.

The intensity of cosmic rays in the upper atmosphere—up to a height of 22 km., corresponding to an atmospheric pressure of 37·5 mm. mercury—has been determined by Prof. E. Regener and G. Pfotzer with an apparatus recording only vertical rays. The curve shows a 'hump' in the intensity at a height corresponding to 300 mm. pressure, and a maximum at 100 mm. pressure, apparently due to primary or secondary components of cosmic rays. At greater heights there is a rapid fall in the intensity of vertical cosmic rays, but the authors expect that a certain definite intensity of cosmic rays (coming from interplanetary space) will be found at the top of the atmosphere.

By means of the new technique of registering the tracks of ionised particles upon photographic plates in the emulsion of which a small amount of a suitable substance (in this case, samarium sulphate) has been incorporated, Prof. H. J. Taylor has confirmed the emission of α-particles by samarium. The element also emits particles of greater penetrating power, which appear to be positively charged hydrogen atoms (protons).

The energy and relative number of positive electrons from a radioactive source has been determined by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew, and compared with the similar 'positron spectrum' produced by γ-rays in thin lead foil. From these, and from further results obtained by irradiating lead with γ- and β-rays together and with γ-rays alone, the authors conclude that when lead (or aluminium) is submitted to rays from such a source, most of the positrons produced are due to the γ-rays of radium C.

Dr. G. I. Finch and A. G. Quarrell submit photographs and measurements of 'extra' rings obtained by electron diffraction—by passing electrons through thin films of metals. The rings differ according to the nature of the metal and the treatment it has received. The authors emphasise that when studying the absorption of gases by metals by this method, it is important to exclude the formation of 'extra' rings due to the presence of grease or to amalgamation.

Prof. L. Vegard states that he has obtained good X-ray diffraction photographs by the powder method with γ-oxygen, one of the three forms of solid oxygen. He deduces that its crystalline structure may be represented by a cubic cell containing eight rotating oxygen molecules grouped into pairs (O_2–O_2), the distance between the two molecules of a pair being somewhat smaller than the minimum distance between neighbouring pairs. γ-Oxygen, Prof. Vegard states, represents the closest cubical packing of pairs of oxygen molecules, and its structure is similar to that of α-nitrogen and α-carbon monoxide.

Cinematographic records showing the transition and growth of crystals of α-iron (magnetic) in the original γ-iron (non-magnetic) in the neighbourhood of the transition point 900° C. have been obtained by Dr. W. G. Burgers and J. J. A. Ploos van Amstel, by means of an 'electron-microscope' with one magnetic lens.

Sir Joseph Larmor directs attention to the difficulty and expense involved in obtaining scientific periodicals and other publications with restricted circulation, and protests against the high price of certain Government publications.

Research Items

Kisi of Liberia

AMONG ethnographical papers presented to Section H (Anthropology) at the Norwich meeting of the British Association was an account by Miss E. D. Earthy of the Kisi of Liberia, a tribe little known to anthropologists, which speaks a semi-Bantu language, although surrounded by peoples of the Sudanic linguistic group, and has been little affected by European culture contact, being economically independent of foreign civilisation. Their villages are built on hill-tops in the forest, where the borders of Liberia, French Guinea and the Sierra Leone Protectorate meet. The people are probably of mixed Hamitic-Negro stock with a strong pygmy strain in some of the villages. The ruling class are of fine physique, and live by hunting, fishing and agriculture. Their chief food is rice seasoned by palm oil. Their currency is twisted iron rods, used for the bride-price and commerce in the markets. The paramount chief rules over a large number of clans and sub-clans. The tribe is totemic, and inter-totem marriage is forbidden. Polygamy prevails. Names up to the sixth child of either sex show the order in which the children are born. Both sexes have to undergo a severe course in the bush initiation school. Their religion is a mixture of animism and totemism. An important sacrificial rite takes place when the rice harvest is over. The sacrifice is performed on the top of a high and inaccessible mountain, of which the name is never divulged to strangers. The office of priest, as is that of trumpeter, is hereditary. The sacrifice is a sheep, which is slain by the priest, the blood being collected in a bowl held by a member of a special family, in which the office is hereditary, who touches the hand of each worshipper with the blood, which the latter must then rub over his face, especially the forehead. The priest then prays for the prosperity of the people and country. In returning, no one must look back at the mountain or fall, otherwise he will die.

Prehistoric Copper and Bronze

SOME further results of the analyses of copper and bronze from excavations in Sumeria and from other archæological sites in the Near and Middle East are given in the report of the Committee on Sumerian copper presented to Section H (Anthropology) at the recent Norwich meeting of the British Association. A chronological arrangement by Dr. Plenderleith of the results of the Committee's examination of specimens from Ur shows that the single object examined from the al'Ubaid period is of nearly pure copper; of eleven objects from the Royal cemetery, nine are bronze, while two contain only small proportions of tin; and that while both copper and bronze occur in the Sumerian period, objects of the Sargonid period are either of copper or contain only a small proportion of tin. To these must now be added four objects from Jemdet Nasr in which copper varies in percentage from 48·18 to 67·23; all show arsenic, varying from 0·20 to 0·93, and two show nickel in the proportion of 0·02 and 0·075 respectively. A copper rod from the same site, which was less corroded, gave percentages of copper, 82·33, nickel, 0·05, arsenic, 0·34, sulphur, 0·11. In none of these was tin present. In twenty-two specimens supplied by the Oriental Institute of Chicago from Tell Asmar, Khafaje and Alishar Huyuk, nickel was absent in two samples only, from Alishar. The Akkadian material from Tell Asmar showed no tin, and this metal was also absent from two objects of early dynastic age from Khafaje, and present only in the proportion of 0·40 in an early dynastic chisel from Tell Asmar. Some interesting results were obtained from copper objects from Tell Duweir (Lachish), Palestine. The metal had clearly come from sources other than those from which the Mesopotamian metal had been derived. It was, therefore, of special interest to examine ores and slag obtained from the Arabah district by Mr. J. L. Starkey. The ores proved to be a mixture of azurite and malachite with no tin, arsenic, nickel or lead.

The 'Rain Frog' of China

THE egg-laying habits of the rain-frog, *Kaloula borealis*, are correlated with amount of rainfall and temperature, so that under proper temperature conditions (something over 20° C.) a minimum threshold of about 40 mm. of rainfall is necessary. This amount of rainfall does not indicate the depth of the pools needed for egg-laying, since these may be drainage centres of larger areas (Ju-chi Li and Chang-shan Lin, *Pekin Nat. Hist. Bull.*, 10, 45; 1935–36). Larval development provides another aquatic complication, for unless the pool in which the eggs are laid lasts through three weeks, the larvæ cannot complete their development. Furthermore, the larvæ feed upon unicellular organisms, and so are dependent upon the influx of organisms and their multiplication, which again depend upon washings from the heavy rainfall and appropriate temperature. The food habits of the adults are somewhat similar to those of frogs and toads, and since they prey upon injurious ants belonging to the Formicidæ, it is possible that thereby they benefit mankind.

Malformation in Adriatic Copepods

FOLLOWING his previous work on the same subject, Dr. Fritz Fruchtl summarises his records of malformation in various appendages of several marine copepods in his paper "Beitrag zur Kenntnis der Missbildungen adriatischen Planktoncopepoden" (*Sitz. Akad. Wissen. Wien.* Math.-naturwiss. Klasse. Abt. 1. Mineralogie, Biologie, Erdkunde, 143, 5 bis 7 Heft; 1934). These include abnormal antennæ, caudal furca and legs, the last being most frequently affected. *Temora stylifera* has been found by the author to vary considerably in both the absolute and relative length of the caudal furca and the relation of the branches to one another; but there are also abnormalities in the setæ, and a peculiar form is here shown in *Temora longicornis*, in which one branch is quite unlike the other and much shorter, the armature differing greatly. A table is given of all the malformations seen, with dates and localities, involving ten species of the genera *Calanus*, *Calocalanus*, *Aetidius*, *Temora*, *Acartia*, *Sapphirina* and *Corycoeus*. It is evident that such malformations are of not infrequent occurrence, and it is of importance to note these carefully when observed.

Deterioration of Cut Sugar Cane in Egypt

ALTHOUGH the loss in sugar value of the cane during a delay between harvesting and milling has been mentioned by investigators in other sugar-producing countries, the observations made by Dr. Rosenfeld in the Egyptian field cannot be over-emphasised from the planter's point of view (Bull. 155, Ministry of Agriculture, Egypt). Certainly the fact that a four days delay in delivering the cut cane means the evaporation of all the profits on the harvest serves to give point to the investigations at Mallawi. Though the extent of loss varies with the type of cane grown, yet in no case is it small enough to make a delay in delivery anything but a serious risk—even in the coolest harvest time when deterioration is least. At the same time, in cases of unavoidable delay, certain elementary precautions will minimise the loss. Of the actual manner of deterioration, the 'masking' of the remaining sucrose by the invert sugar, glucose, is perhaps the most interesting, for it means that loss is not only due to inversion but also to the formation of the glucose on the sucrose crystals, so that the latter cannot be extracted. From the facts put forward it seems that a delay in harvesting, until immediate transport of the cut cane is assured, is at any time preferable to a hold-up between the harvest and delivery of the cane.

Production of Vegetables for Canning

SOME problems in the growing of vegetables for canning was the subject of a paper read on September 6 by Mr. W. B. Adam to Section M (Agriculture) at the Norwich meeting of the British Association. The canning industry in England has developed rapidly since 1928, and although the present output is still about one twentieth of that in the United States, it has now reached approximately 100 million cans per year. The research work, conducted at Campden, deals with all aspects of the industry, selection of variety being one of the most important lines of work, particularly as vegetables for canning are grown under contract, and a steady supply throughout the season is essential. Biochemical investigations are also being carried out to determine the age at which the vegetables can satisfactorily—the sweetness of green peas, for example, is lost after a certain stage in their development owing to the sugars being replaced by starch. Technical problems inevitably play a prominent part in the industry, questions of colouring being among those which have received special attention, and a new process for the treatment of green vegetables has been evolved at Campden. Vegetables are canned within a few hours from picking, so that they are actually preserved in a fresher condition than those bought on the market for home cooking. Further, biological investigations in the United States have shown that canned vegetables generally have a higher vitamin value than those cooked in the usual fashion, so that from a dietetic point of view the vegetable canning industry is entirely justified.

Air Seasoning of Indian Timbers

WITH the increasing demand for timber, the great waste due to the common use in the tropics and sub-tropics of green timber has gradually received recognition. If insect attack is left out of the question, the material in log form is subject to splits, shakes, end-cracks and decay, whilst converted timber owing to bad stacking and other evils incurs even greater loss by depreciation. Furthermore, the climate itself, with the great degree of variation in temperature and moisture throughout the year, results in enormous waste, both before and after the finished article has been turned out. The difficulties in India, as is pointed out in Dr. S. N. Kapur's "Manual on the Air Seasoning of Indian Timbers" (Forest Research Institute, Dehra Dun. Delhi: Manager of Government Publications, 1934), are due to the absence of any large-scale wood-using industries in the country other than railway workshops and ordnance factories, most of the wood-working industries in India being carried on in a small way, usually employing manual labour, their requirements of timber being small and consisting of a variety of species and thicknesses which preclude the installation of any expensive plant like seasoning kilns. It is for this reason that the author holds the opinion that an improvement in the general wood utilisation in India can only be brought about by the introduction of proper methods of air seasoning. It is, therefore, with this question of air seasoning that the manual deals under sections devoted to moisture, shrinkage, the mechanism of wood seasoning, seasoning defects and their causes, the practice of girdling trees before felling (as is usually done with teak), water seasoning, green conversion, requirements of seasoning such as sheds, etc., practical methods of stacking timbers for seasoning, and the seasoning of railway sleepers. In a second part, the author deals with the air seasoning characteristics of various species.

Caledonian Orogeny of North-East Greenland

IN his preliminary report on this subject, C. E. Wegmann presents a discussion of the problems involved which is a model of its kind (*Medd. om Grønland*, 103, No. 3, 1935). He shows that the sediments of the East Greenlandic geosyncline (up to 9000 m. thick over a width of not less than 200 km.) indicate a deep-going interruption of the Greenlandic shield on such a scale that the geosyncline must be looked upon as a tectonic element of first order in the architecture of the earth's crust. In Caledonian times, immense migrations of sub-crustal material due to igneous activity took place. In part, the material penetrated the rocks by a process of 'molecular migration', leading to the formation of large felspar phenocrysts, 'augen gneisses' and migmatites in great variety. Wegmann draws a distinction between a migration of elements through a stationary framework and a migration through a framework undergoing internal and external movements. He points out that where quartzites and schists are interwoven with felspar, not all the material has migrated, but only the part of it which rendered possible the formation of the felspar. When crystallisation outlasts the movements, the relict structures disappear, and the result is a granite of more or less massive character which nevertheless is itself only a mixed rock that has migrated as a mobile mass from its original place of development. Such granite is not to be regarded as the source of the migrating elements. The conclusion is reached that igneous phenomena so transformed the infra-structure of the Caledonian material that the conception of the mountain complex as being of germanotype character is deprived of support based on the opinion that the basement rocks are rigid, undeformed Archean masses. Every

line of evidence indicates that the mountain chain must be regarded as a deep-going interruption of the Pre-Cambrian shield. The later history is briefly summarised; further problems are indicated; and a detailed memoir on the whole—which will be eagerly awaited—is promised at a later date.

Geography of the North Sea Bed

A BATHYMETRICAL map of the North Sea floor compiled from the Admiralty Charts accompanies a paper on the subject by Mr. R. G. Lewis in the *Geographical Journal* of October. The map brings out a number of features that are often overlooked and raises a number of problems. River erosion explains many of the features, and Mr. Lewis traces what he calls the Silver River, the extended Rhine, to the west of the Dogger Bank and then northwards by changing courses. But more difficult to explain are certain features that are not clearly the outcome of river work, and suggest tectonic movements. There are a number of narrow elongated depressions. In the English Channel there are comparable troughs not connected with the river that once flowed there. Mr. Lewis suggests that these may be due to folds on the floor which have disappeared. A fold would hold up the water behind it. The water would flow along the course of the fold in a deepening channel until it found an outlet. Eventually the flow of water would destroy the anticline. Another problem that awaits explanation is the failure of the sand and gravel which lies over most of the floor to fill these depressions. The small elevations south-east of the Dogger Bank suggest not erosional features so much as heaps of moraine matter.

Specific Heats of Crystals

THE August 1 issue of the *Proceedings of the Royal Society, A*, contains the Bakerian Lecture by Prof. R. H. Fowler on "The Anomalous Specific Heats of Crystals". The lecture contains a general survey of the theoretical position and gives a new tentative theory of the contribution made by molecular rotation. The theory of specific heats is primarily the construction of the free energy function of the solid in terms of an assumed model for the crystal lattice, and this in turn involves the construction of a 'partition function' giving the probability of the different energy states. Assumptions were made by Einstein and by Debye which led to partition functions and to specific heat formulæ, and Debye's work has been recently extended by Blackman in a detailed consideration of cubic lattices. Fowler classifies as 'anomalous' any variation of the specific heat which does not arise from normal modes of vibration (small oscillations) of the atomic lattice. Such anomalies must arise in any case in which there is not a monotonic increase of specific heat with temperature. He classifies them into three types. In the first type the anomalous specific heat occurs around a certain temperature and, in some cases, in any event, the extra specific heat is used in exciting the atoms, for example, to states of higher orientational energy. The second type is distinguished by sudden disappearance of the anomaly above a certain temperature, and its explanation involves co-operative interactions between atoms of the lattice. Examples are the ferromagnetic interaction disappearing above the Curie point and the order-disorder transitions recently described by Bragg and Williams. The rotational contribution specially discussed by Prof. Fowler is of this type. The third type is the discontinuous absorption of heat at a transition temperature between phases.

Use of Electron Lenses for β-Rays

O. KLEMPERER (*Phil. Mag.*, Oct.) has applied to β-ray spectroscopy the known focusing effect of a short coil on electron beams passing axially through it. A short coil, with or without an iron mantle to concentrate the field, was used to focus the β-rays from a small radioactive source (Th *C*) on the window of a Geiger counter placed about a metre away. By varying the current in the coil, the power of the lens may be varied, and different β-ray energy groups brought into focus. This method is analogous to the focal isolation of light according to the method of Rubens and Wood, and good β-ray spectra could be secured. A further development was the construction of a magnetic analogue of an ordinary spectroscope, with magnetic lenses for telescope and collimator and a uniform magnetic field for a deflecting prism, but the experiments have not yet been completed.

Cerin and Friedelin

BY extracting ground cork with alcohol, Chevreul in 1807 obtained a material which he believed to be a wax and called cerine. In 1898, Thoms obtained it in a pure state and believed it to be related to the phytosterols because of its colour reactions. Another constituent of cork extract was prepared in 1899 by Istrati and Ostrogovich who, in return for the interest taken by Friedel in their investigation, named it after him. N. L. Drake and R. P. Jacobsen (*J. Amer. Chem. Soc.*, 57, 1570; 1935) have now re-investigated these materials. They find that the empirical formulæ of friedelin is $C_{30}H_{50}O$ and that of cerin $C_{30}H_{50}O_2$, plus or minus 2H, within the limits of error. The hydrocarbon to which friedelin is related is $C_{30}H_{52}$. The molecular weight was determined by the saponification of several enol esters. The colour reaction was not due to pure friedelin but to a sterol present as impurity. The presence of a double bond in friedelin is inferred from molecular refraction data and the colour reaction with tetranitromethane. Addition of bromine and hydrogenation were not effected, but one of the double bonds of ergosterol behaves in this way.

A Rectifying Valve for Radiological Work

MESSRS. PHILIPS METALIX, of 145 Charing Cross Road, W.C.2, have sent us a booklet on high tension rectification which should prove useful to the radiologist and the radiological engineer. They will find in it an explanation of the functioning of rectifying valves and the relative efficiency of various types. There is also given an account of the gas-filled valve, their latest production. They point out that every operation in the production of radiograms, from the time of switching on the mains until the removal of the film from the fixing bath, must be performed with the highest efficiency, if consistently good results are to be obtained. As a rule, the rectifying valve does not receive the consideration it deserves, and yet its performance is essential to good work. It often causes additional expense by wastage of films, and its failure can irremediably damage the X-ray tube and other valves in the circuit. The technical matter contained in this booklet will assist the radiologist in understanding present-day equipment.

International Institute of Documentation

COPENHAGEN CONGRESS

MICROPHOTOGRAPHY, as a means of distribution of data, rivalled such veteran subjects as decimal classification and cataloguing in discussions at the Copenhagen Congress of the International Institute of Documentation, on September 10–14. Marking the fortieth anniversary of the world bibliographic or documentation movement that arose out of the 1895 International Congress of Bibliography, this thirteenth Congress in a part of its programme provided, in effect, a 'clearing house' for current progress upon microphotographic duplication as visualised or practised in many lands.

Nearly fifty reports were presented to the Congress, and the advance volume of the Congress is an important addition to the literature of finding, classifying, preserving and distributing written information.

Held under favourable weather conditions of Copenhagen's waning summer and arranged with Danish hospitality by the local committee, of which Oscar Thyregod was the leader, the Congress brought together representatives from about a dozen countries to discuss problems of mutual interest in a medley of German, English and French.

The president of the Congress, Dr. J. Alingh Prins, president of the Dutch Patent Office, said in an opening address that documentation has three stages: (1) investigation as to what has been written about a subject or put into the form of a document; (2) filing the material so that the place of each subject may be determined instantly; (3) placing the material at the disposal of those who need it.

With regard to filing and classifying material, Dr. Prins said: "Collected material, which is not filed, is of little importance. What system of classification should be adopted? In theory this does not matter; the main thing is, that *one and the same* system is used nationally and internationally. We are convinced that the most serviceable system is the decimal system, invented by Melvil Dewey, and considerably improved in Brussels by Lafontaine and Otlet and since then brought to a high stage of development by the international classification committee of our Institute under Donker Duyvis, with the co-operation of a large number of prominent persons from different countries."

Decimal classification, and the sessions of the committee charged with keeping the system in step with advancing knowledge, bulked large on the programme, with reports on its use in Germany, Switzerland, England, America, Holland, Norway, Sweden, Denmark, Finland and other countries.

Of fundamental importance was the paper presented by Dr. S. C. Bradford, keeper of the Science Library, London, which analysed the situation surrounding library service in the general field of science, including societies, research institutions, business and industrial organisations, etc., and came to the conclusion that a central library of science and technology would alleviate many of the disabilities under which scientific and technical work is carried out at the present time. A communicated paper by E. Lancaster Jones explained the classified bibliography operated by the Science Library. A paper by Watson Davis, director of Science Service, Washington, told of suggested applications of microphotographic duplication in making available existing literature in libraries and publishing scientific papers and monographs that cannot at present be issued promptly or in full.

Television was foreseen as a future tool in library service by Dr. Walther Schurmeyer, director of the Library of Art and Technology at Frankfurt, whose paper stressed primarily the possibility of applying photographic methods to the distribution of information from libraries.

How photographing of library cards upon motion picture film, and making enlargements from these convenient and inexpensive negatives, is done was the subject of a paper presented by Paul Vanderbilt, librarian of the Pennsylvania Museum of Art, who used this technique experimentally in connexion with a union catalogue of Philadelphia libraries. Experience with use of film copies and microphotoprints at the Huntington library in America was reported in a communication from Dr. L. Bendickson, and there was also a communicated report on photographic methods in connexion with documents and libraries by Dr. H. Joachim, director of the Zeiss Ikon concern at Dresden.

The question of the photocopying of books and literature in view of the copyright laws and rights of authors was the subject of one session. The standardisation of the format for film copies so as to simplify the exchange of film copies between different countries was urged in resolutions, with a recommendation for the use of 35 mm. film, perforated both sides, with width of image of 24 mm. and a reduction of approximately 12 to 1.

The International Institute of Documentation reaffirmed at the Congress its desire to "work with every international organisation which pursues related aims, for example, in the field of publication and of the working organisation of special publication such as film".

Several related efforts in the field of documentation were made known and explained by documents distributed at the congress. The International Institute of Intellectual Co-operation of the League of Nations reported the progress in its endeavour to co-ordinate world efforts in the field of documentation, and the International Office of Chemistry, Paris, made available a report, "L'Utilisation du Film comme Support de la Documentation", giving proceedings of its April conference.

The prevailing spirit of the meeting was the hope that there would be co-operation effected through the International Institute of Documentation with both international organisations dealing with particular fields of knowledge and national organisations that bring together the documentation activities in various geographical areas.

Mingled with the meetings there were visits to libraries, publishing firms, schools and places of historical interest. These events and lunches arranged in famous Copenhagen restaurants allowed informal discussions of mutual problems in many languages, a function of any Congress that is often even more important than the set and formal proceedings.

International and Absolute Electrical Units

AT the recent meeting in Paris of the International Committee of Weights and Measures, the subjoined draft memorandum relating to international and practical absolute electrical units was approved for publication. The document makes clear the position of the Committee and shows that for practically all engineering purposes the change to the suggested new units involves no difficulty.

1. In accordance with the authority and responsibility placed upon it by the General Conference of Weights and Measures in 1933, the International Committee of Weights and Measures has decided that the actual substitution of the absolute system of electrical units for the international system shall take place on January 1, 1940.

2. In collaboration with the national physical laboratories the Committee is actively engaged in establishing the ratios between the international units and the corresponding practical absolute units.

3. The Committee directs attention to the fact that it is not at all necessary for any existing electrical standard to be altered or modified with a view to making its actual value conform with the new units. For the majority of engineering applications the old values of the international standards will be sufficiently close to the new for no change even of a numerical nature to be required. If for any special reason a higher precision is necessary numerical corrections can always be applied.

4. The following table gives a provisional list of the relations between the international units and the corresponding absolute practical units, to the fourth decimal place. Since differences exist between the standards of the international units held by the various national laboratories affecting the fifth decimal place, and, further, because all the laboratories which have undertaken determinations of the values of their standards in absolute measure have not yet obtained final results, the Committee does not consider it desirable for the present to seek a higher precision. At the same time it hopes that it will be possible to extend the table of these ratios with a close approximation to the fifth decimal place well before the date fixed for the actual substitution of the practical absolute system for the international system.

1 Ampere	International	=	0·999 9	"Ampere absolute"
1 Coulomb	,,	=	0·999 9	"Coulomb ,,
1 Ohm	,,	=	1 000 5	"Ohm ,,
1 Volt	,,	=	1·000 4	"Volt ,,
1 Henry	,,	=	1·000 5	"Henry ,,
1 Farad	,,	=	0·999 5	"Farad ,,
1 Weber	,,	=	1 000 4	"Weber ,,
1 Watt	,,	=	1 000 3	"Watt ,,

Sixth International Congress of Entomology

THE Sixth International Congress of Entomology, attended by some four hundred delegates, was held at Madrid on September 6–12. On account of the financial restrictions, some of the mid-European countries were not so fully represented as at past Congresses, but despite these difficulties, entomologists from practically every country were present. The opening session had as its chairman His Excellency the President of the Spanish Republic, who greatly impressed the Congress by his personality and warm welcome.

The Congress itself was presided over by that veteran entomologist, Dr. I. Bolivar Urrutia, director of the Museo Nacional de Ciencias Naturales, Madrid. A heavy programme, divided into sections devoted to general, ecological, agricultural, forest, medical and veterinary entomology, with, in addition, sessions allotted to apiculture and nomenclature, provided something of interest for everyone, and considering the warm weather and the variety of languages in which the papers were presented, the meetings were very well attended. As these papers will be published and may then be read and digested in the quiet of the study, it is unnecessary to detail them severally by name here, but we might say that some of the illustrated ones, as, for example, Dr. F. W. Edwards's account of the British Museum Expedition to Ruwenzori, Dr. B. Mayne's film of the life-cycle of the malarial parasite in the body of the mosquito, Dr. Escalera's one on apiculture, and Dr. Kamal's 'talkie' of *Prodenia littoralis* seemed to be much enjoyed. The Sunday sessions were held at El Escorial, and though most of the delegates spent their time exploring the beautiful and historic buildings and collecting their favourite families of insects in the neighbourhood, the meetings were well attended by the more enthusiastic seekers after knowledge.

Only a small part of the time, however, was devoted to serious scientific matters. The President of the Republic received and entertained the Congress at the Palace, and entomologists must have felt just a little awed on walking up the grand staircase between the lines of fully-accoutred lifeguards; the Mayor of Madrid entertained it to music, and during the subsequent proceedings, outlined to some of the members in excellent English the town-planning schemes of the city; the organisers, to a charming *fiesta* of Spanish art, to lunches and *merienda* and a final evening banquet, and bore the expenses of excursions to such historic places as El Pardo, El Escorial (as mentioned above) and Toledo. A whole day was devoted to a sight-seeing trip to the Guadarramas, the Alpine Biological Station being visited *en route*, the Forest of Valsain, San Ildefonso (La Granja) and Segovia, where members gazed with delight on the beautiful west façade of the cathedral lit up by the setting sun. An afternoon visit to

Aranjuez provided an opportunity of viewing the luxuriant growth produced by irrigation.

Honorary doctorates were conferred by the University of Madrid on Prof. M. Caullery, University of Paris; Dr. R. Goldschmidt, director of the Kaiser-Wilhelm-Institut, Berlin-Dahlem; Dr. R. Jeannel, Muséum Naturelle d'Histoire, Paris; Prof. F. Silvestri, Portici, Italy; and Mr. B. P. Uvarov, Imperial Institute of Entomology, London.

During the week preceding the meeting some of the members went on an excursion through the Picos de Europa under the guidance of Dr. F. M. de la Escalera, and after the Congress others visited southern Spain and the Canaries.

It is to the admirable organisation of the secretary, Dr. C. Bolivar y Pieltain, and his committee that the success of the recent Congress was due, and the lavish hospitality set a standard which few countries could hope to live up to, but there will remain in our memories also the courtesy and helpfulness of the people of Madrid to those who were ignorant of both customs and language.

It was decided to hold the seventh International Congress of Entomology in 1938 at Berlin under the presidency of Dr. E. Martini, and it is expected that the ninth will be held at Amsterdam in 1945 to coincide with the centenary celebrations of the Dutch Entomological Society.

Tercentenary of the University of Budapest

THE recent celebration of the tercentenary of the Royal Hungarian Péter Pázmány University of Budapest was worthy of a people that has played a great part in the intellectual and political life of Central Europe. The Hungarian nation began its corporate life in 896 when the Magyars entered the country from the plains of southern Russia and the slopes of the Carpathian mountains. In the fourteenth century, and again in the fifteenth century, universities were founded, but they lasted only a comparatively short time and none survived more than a few years after the disastrous Turkish victory in 1526. In 1635, when the greater part of Hungary was still under Turkish rule, Péter Pázmány, Archbishop of Gran (Esztergom) and later Cardinal, Prince Primate, founded a new university at Nagyszombat; more than a hundred years later it was transferred to Buda and in 1783 to Pest. The two cities Buda and Pest were united in 1872. Since 1922 the University has been known as the Royal Hungarian Péter Pázmány University of Budapest. This leading university of Hungary has now more than 5,000 students: its success is a remarkable demonstration of the intellectual aspirations and the national spirit of a nation which was deprived by the Treaty of Versailles of the greater part of its territory.

Unfortunately no list of delegates was given to the representatives of foreign universities and academies who assisted at the celebrations, and it is therefore impossible to mention the names of the foreign delegates. The celebrations began in the evening of Wednesday, September 25, with a reception in the Hotel Gellért. On the Thursday morning, the delegates and the university staff met in the great hall of the University and went in procession to the neighbouring University Church, where his Eminence the Cardinal Prince Primate, Dr. Jusztinian Serédi, assisted by a brother cardinal from Vienna and several bishops, celebrated Mass: Liszt's music was beautifully rendered. It was a memorable service. At the conclusion of the service the foreign delegates signed their names in a special commemorative book and, after visiting the University library where a collection of charters and old books relating to the Péter Pázmány foundation was exhibited, were entertained at luncheon in the Grand Hotel Hungaria, where several speeches were made by foreign ministers and some of the delegates. In the evening an invitation performance at the Opera House, illustrative of Hungarian drama and national life, was followed by a reception given by the Minister of Education.

On Friday morning, September 27, the delegates of the University staff met under the central dome of the Parliament House to take part in the principal academic event of the celebrations. His Serene Highness, the Regent of the Kingdom of Hungary, their Royal Highnesses the Archduke Joseph and his son, the Archduke Francis Joseph, were present. The Rector Magnificus, Dr. Julius Kornis, opened the proceedings and, after other members of the University had spoken, a representative of the University of Bologna spoke on behalf of the foreign universities, and the foreign secretary of the Royal Society of London was asked to speak on behalf of the whole body of academies. The latter paid a special tribute to the memory of one of the greatest sons of Hungary, the founder of the Hungarian Academy, Count István Széchenyi, "a man whose enlightened attitude towards learning, breadth of vision and spiritual ideas are worthy of our most respectful and grateful homage". Delegates were then called upon to present their addresses: English, Scotch and Welsh universities were represented, universities of the Irish Free State, of Austria, Belgium, Egypt, Denmark, Latvia, France, Finland, Germany, Greece, Holland, Italy, Norway, Poland, Spain, Sweden, Switzerland, the United States of America, and other countries.

In the afternoon some of the delegates were present at the laying of the foundation stone of a new University hospital for lung diseases. Each medical professor has his own University hospital. An informal entertainment was given by students in the evening.

In the morning of September 28 a large number of honorary degrees were conferred. Unfortunately, the two English graduands, Sir Charles Sherrington and Sir F. Gowland Hopkins, were not able to receive their degrees in person.

In the afternoon the Regent received the delegates in the Royal Palace and talked with many of them with equal fluency in German, French and English. In the evening the visitors had the privilege of hearing Beethoven's "Missa Sollemnis" with an impressive accompaniment of a liturgical drama produced by the director of the National Theatre.

The celebrations were admirably organised: the attractive Hungarian national uniform worn by the University officers, the brilliant robes of the cardinals, the white, brown and black vestments of members of monastic orders, and the variety and wealth of colour represented by the gowns and hoods of delegates contributed to the gaiety and splendour of a great occasion. The celebration was an important national event which made a very favourable impression upon the international company and created a feeling of sympathetic interest in the welfare of a courageous nation. Delegates who had the good fortune to be guests of the University in one of the most beautiful of European cities will long retain the pleasantest memories of the friendliness of the Rector Magnificus, the Ministers of State and the University officers with whom they came into contact.

Educational Topics and Events

CAMBRIDGE.—The managers of the Balfour Fund have made a grant of £100 to F. R. Parrington, of Sidney Sussex College, for researches on the fish fauna of the Achenarass quarries.

It is proposed to confer the degrees of M.A. and M.D. *honoris causa* upon Dr. J. A. Ryle, regius professor of physic, and the degree of M.A. on Dr. G. P. McCullagh, University demonstrator in pathology.

LEEDS.—Mr. Frank Stuart Atkinson has been appointed to the chair of mining, in succession to Prof. Ritson, who takes up his appointment at the Royal School of Mines at the beginning of January next. Mr. Atkinson is a qualified mining engineer. He was educated at Chesterfield Grammar School and the University of Sheffield, and has had a long and varied experience of practical work; he has been manager of the Hatfield Main Colliery since February 1927.

LONDON.—The title of Edwards professor of Egyptology in the University has been conferred on Mr. S. R. K. Glanville, in respect of the post held by him at University College.

The title of emeritus professor of bacteriology in the University has been conferred on Dr. J. W. H. Eyre, formerly University professor of bacteriology at Guy's Hospital Medical School; and that of emeritus professor of civil engineering in the University on Mr. A. H. Jameson, who has retired from the University chair of civil engineering at King's College.

OXFORD.—Dr. John Mellanby, professor of physiology in the University of London, has been appointed to the Waynflete professorship of physiology, to hold office from January 1, 1936.

The Council of the Institution of Naval Architects has made the following awards: 1851 Exhibition Commissioners post-graduate scholarship in naval architecture, £250 per annum for two years, to Mr. Harrison Lackenby, of Armstrong College, Newcastle-upon-Tyne; Sir William White post-graduate scholarship in naval architecture, £150 per annum for two years, to Mr. Ian C. Bridge, of the University of Glasgow; Earl of Durham Prize, to Mr. D. H. Burnett, of H.M. Dockyard, Devonport.

Science News a Century Ago

Meeting of the Entomological Society

AT a meeting of the Entomological Society held on November 2, 1835, the president, the Rev. F. W. Hope, being in the chair, several communications were read, one of which was a notice of the ravages of the black caterpillar upon the leaves of the turnip in Kent, by W. W. Saunders. "Relative to this communication Mr. Yarrell stated some additional circumstances regarding the destruction of the turnip last summer and autumn, by the insect in question, which were the larvæ of a species of Saw-fly (Tenthredinidæ) termed by the farmers 'the blacks'. In the dry summer of 1818 these insects were equally destructive, and so rapid is the destruction caused by them, that in a couple of days a fine field of turnips is reduced to the mere skeleton of the leaves. Mr. Hope gave an account of some other insects which had this year been equally injurious to the turnip in Shropshire, Herefordshire and Worcestershire and suggested several plans for their destruction."

Beginning of Faraday's Researches on Electrostatics

"HAVE been thinking much lately," wrote Faraday in his Diary on November 3, 1835, "of the relation of common and voltaic electricity; of induction by the former and decomposition by the latter, and am quite convinced that there must be the closest connexion. Will be first needful to make out the true character of ordinary electrical phenomena. The following notes are for experiment and consideration.

"Does common electricity reside upon the surface of a conductor," he went on, "or upon the surface of the electric in contact with it? I think upon the electric, and must work out the results on that view. It will make a great difference in the collation and connexion of the various electrical phenomena and also in their explication."

Then follow a dozen or so pages, written on the same day, of speculation on such points as the effect of the form of a conductor on its electrical behaviour, on the relation of two surfaces under induction, and on the state of the dielectric, or as he called it, the "electric", during the persistence of inductive action. Together with the queries are ideas and suggestions for experiments by which they may be tested.

This was the beginning of Faraday's researches on electrostatics. The work on electrochemistry had been completed early in the year, and very little had been done during the summer months. Now, in the autumn, he was ready to begin again, and the first step was to put down on paper the ideas for experiment that had come crowding to his mind; next, in a few weeks time, he would be devising the necessary apparatus.

New Session of the Geological Society

ON November 4, 1835, the Geological Society held its first meeting of the session. A paper by Dr. Buckland was first read on the discovery of the beaks of four extinct species of fishes, referable to the genus *Chimæra*, and found in the Oolitic and Cretaceous series of England. The paper was accompanied by an appendix by M. Agassiz, describing the distinctive characters of each species.

A communication by Mr. Murchison was next read, containing an account of the quarry in the new red sandstone at Rhone Hill, near Dungannon, in which

numerous ichthyolites had been found, and of the geological structure of the adjacent district. A slab of the sandstone, presented to the Society by Mr. Greer, the proprietor of the quarry, was laid upon the table, and exhibited on a surface not exceeding two feet square impressions of above 250 fishes.

M. Agassiz afterwards gave a succinct account of his researches on English fossil fishes. The number of species which he had noticed amounts to about 400, of which 300 were new, and he stated that the specimens, too imperfect to be described at present, announce the existence of a still greater number of species.

King of Denmark's Medal for Astronomers

IN the *Athenæum* of November 7, 1835, was a statement regarding the founding by the King of Denmark of a gold medal, of the value of twenty ducats, to be given to the first discoverer of a telescopic comet. The discoverer who desired to be considered for the award, if in any part of Europe except Great Britain, had to send immediate notice of his discovery to Prof. Schumacher, of Altona, and if in Great Britain, or any other quarter of the globe except the Continent of Europe, to Francis Baily, of Tavistock Place, London. The medal was to be adjudged twelve months after the discovery of the comet, and no claim could be admitted after that period had elapsed. Prof. Schumacher and Mr. Baily were to determine whether a discovery was to be considered established or not, but if they differed in opinion, Dr. Olbers, of Bremen, was to decide between them.

Societies and Academies

PARIS

Academy of Sciences, September 30 (*C.R.*, 201, 533–572). CHARLES CAMICHEL, LÉOPOLD ESCANDE, ETIENNE CRAUSSE and JEAN BAUBIAC: Linear hydraulic elements and the resistance of immersed bodies in permanent or transient regime. RAYMOND MINDLIN: Contribution to the problem of equilibrium of elasticity of an indefinite solid limited by a plane. BERNARD LAFFAILLE and FLORIN VASILESCO: The *flambage* of thin cylindrical plates. JOHN ELLSWORTH: The asymmetry of the light curves of variables with eclipses attributable to a tide lag. F. DUSCHINSKY: The bands in the neighbourhood of spectral lines in the ultra-violet. GASTON DUPOUY and PIERRE JACQUINOT: The proportionality of the deviations in the field in the Zeeman effect of three mercury levels. HORIA HULUBEI: New "*hors diagrammes*" emissions in the $K\alpha$ spectra of elements included between Cu(29) and Rh(45) inclusively. MLLE. O. HUN: The cryoscopic study of the total hydration of the ions of sodium bromide. MLLE. MARGUERITE QUINTIN: The heat of dilution of cadmium chloride. MLLE. SUZANNE VEIL: The electromotive forces due to bringing together metals in gelatine, and the importance of the Volta effect in batteries. JEAN CHÉDIN: The Raman spectrum of nitric anhydride. The Raman spectra of nitric anhydride in organic solutions (chloroform, carbon tetrachloride) differ from those given by the same substance in nitric acid or in sulphuric acid. PIERRE LAURENT: A new compound of phenol and aniline. From measurements of the dielectric capacity of mixtures of phenol and aniline in various solvents (benzene, carbon tetrachloride, cyclohexane and ether) the existence of the compound ($C_6H_5NH_2,2C_6H_5OH$) is deduced, and this has been isolated in the form of colourless crystals melting at 29·2°C. ANDRÉ LÉAUTÉ: The capillary separation of tars. When studying the ascent in capillary tubes of tars and bitumens, it has been noticed that two liquids appear in the tube, the upper a clear yellow fluid, the lower black tar. This explains the appearance of yellow exudations on the surface of tarred roads. ANDRÉ CHRÉTIEN and GEORGES VARGA: Two new compounds of titanium tetrachloride and hydrochloric acid. The cryoscopic study gives indications of the existence of the compounds $TiCl_4$, 6HCl, and $TiCl_4$, 2HCl. The first of these is a new type. JOSEPH HOCH: A new general method of preparation of the *N*-carboxethylketimines, $RR'.C{=}N.CO.OC_2H_5$. The diethylacetals of the ketones are condensed with ethylurethane in the presence of a trace of aniline hydrochloride. JACQUES FROMAGET: The upper Trias of the western border of the Tran Ninh (Haut Laos). CHARLES FRAIPONT: A skull of *Homo neanderthalensis* from the grotto of Engis (Liège). A detailed examination of the small skull found along with the celebrated Engis skull in 1828. ANGEL H. ROFFO: The action of solar rays (ultra-violet) on the skin, and the accumulation of cholesterol. The effect of the sun's rays, especially the ultra-violet rays, produces a local accumulation of cholesterol under the skin. W. KOPACZEWSKI and S. MARCZEWSKI: Anaphylaxy from the point of view of altitude. A study of the effects of reduction of atmospheric pressure, corresponding to an altitude of 10,000 metres, on animals sensitised by an injection of protein. RAYMOND-HAMET: The physiological inversion of the hypotensor effects of adrenaline.

ROME

Royal National Academy of the Lincei, May 19. V. NOBILE: The possibility of new trends in the theory of astronomical refraction and of incidental contributions to the physics of the atmosphere (2). F. SBRANA: Monodrome parallelism on a surface. U. CASSINA: The construction of the plane osculatory to a quartic of the first species. A very simple linear construction of finite character is given. N. SPAMPINATO: (1) Functions totally derivable in a real or complex algebra endowed with modulus (2). (2) A characteristic property of totally derivable functions. B. SEGRE: The bi-relations on the non-developable surfaces of space and the geometric conditions for projective equivalence between them (2). G. BOZZA: The deposition of crystalline suspensions. (1) General theory. The general relationships between the various factors involved in the deposition and separation of crystalline granules from suspensions are deduced for the case when the granules are of such dimensions that the surface influences between granules and liquid are negligible. C. SCHAEFER and L. BERGMANN: A new optical method for the determination of the elastic constants of crystals. Diffraction centres may be formed in a quartz cube by exciting this to rapid elastic oscillations by means of a field which oscillates 10^7 to 10^8 times a second. If monochromatic light is passed through the vibrating crystal, a diffraction figure is formed which depends on the elastic properties of the crystal and on the direction of the rays, but is independent of the form of the crystal and of the type of the excitation. Various examples are described. G. WATAGHIN: The theory of protons and neutrons. By a slight modification of

Dirac's equations, these may be made capable of indicating some of the known properties of protons and neutrons. G. C. WICK: The oscillation and rotation spectrum of the molecule HD. M. SAVIANO: Water metabolism. (9) Variation of the diuresis and urinary *p*H in animals on acidogenic and alkalogenic diets. The more abundant the diuresis, the more nearly does the reaction of the urine approach that of the blood. With animals on an alkalogenic diet, the urine may even become less alkaline than the blood. V. FAMIANI: The development of Jensen's sarcoma in certain particular conditions of nutrition.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 4

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION), at 8.—Prof. I. M. Heilbron: "Chemical Elixirs of Life—the Recent Developments in the Chemistry of Sterols, Lipochromes and Related Compounds" (Jubilee Memorial Lecture).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Prof. Kenneth Mason: "The Himalaya as a Barrier to Modern Communications".

Tuesday, November 5

ROYAL HORTICULTURAL SOCIETY, at 3.30.—(in the Society's New Hall, Greycoat Street, Westminster, S.W.1).—Sir William Wright Smith: "Problems connected with the Classification of Plants". (Masters Memorial Lectures. Succeeding lecture on November 26.)

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. W. Neilson Jones: "Notes on a Biologist's Visit to Southern California".*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. J. B. S. Haldane.*

INSTITUTION OF CIVIL ENGINEERS, at 6.—J. D. Watson: Presidential Address.

Wednesday, November 6

UNIVERSITY OF LONDON, at 5.—(at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1).—Sir Daniel Hall: "The Improvement of Native Agriculture in Relation to Population and Public Health" (Heath Clark Lectures. Succeeding lectures on November 11, 13, 18 and 20).*

ROYAL SOCIETY OF MEDICINE (HISTORY OF MEDICINE SECTION), at 5.—Dr. E. J. Holmyard: "The Pharmacology of Mediæval Islam".

WARBURG INSTITUTE, at 5.30.—H. Mattingly: "The First Age of Roman Coinage" (succeeding lectures on November 13 and 20).*

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: "Norwegian Life in Town and Country".*

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6.—R. A. Watson Watt: Inaugural Address.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—M. J. Leahy: "Stone Age People of the Hagen Area, Mandated Territory of New Guinea" (Film).

INSTITUTE OF CHEMISTRY (LEEDS AREA SECTION).—Dr. C. H. Desch: "Metals in the Chemical Industry" (Jubilee Memorial Lecture).

Thursday, November 7

ROYAL SOCIETY, at 4.30.—F. W. G. White and L. W. Brown: "Some Measurements of the Reflection Coefficient of the Ionosphere for Wireless Waves".

J. P. Gott: "On the Electric Charge collected by Water-Drops falling through a Cloud of Electrically Charged Particles in a Vertical Electric Field".

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Prof. Julian Huxley.*

Friday, November 8

BEDSON CLUB, ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. J. W. Cook: "The Synthesis and Biological Effects of Carcinogenic Hydrocarbons" (Bedson Lecture).

ROYAL INSTITUTION, at 9.—S. R. K. Glanville: "Weights and Balances in Ancient Egypt".

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records, No. 3 (Wood Preservation Series, No. 1) Experiments on the Preservation of Mine Timber—Progress Report No 1. By J. Bryan and N A. Richardson. Pp. ii+10+3 plates (London: H.M. Stationery Office.) 6*d*. net.

Dam the Thames: a Matter of Sanitation, Comfort and Economy; a Plan for a Tideless River in London. Second edition. Pp. 16. (London: Thames Barrage Association.) 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1653 (S. 210): Static Stability Tests of Six Full Scale Twin Float Seaplanes By R. K. Cushing, A. S. Crouch and R. W. Angell. Pp. 20+10 plates. 1*s* 6*d*. net. No. 1657 (S. 215): Water Performance of Seaplanes; Tank Data to determine Effect of Wind, Variation of Loading or a Change of Air Structure. By W. G. A. Perring. Pp. 4+3 plates. 6*d*. net. No. 1662 (T. 3612): Turbulence Tests of the R.A.E. Wind Tunnels. By Dr. R. G. Harris and A. Graham Pp. 6+3 plates. 6*d*. net. (London: H.M. Stationery Office.)

Sale of Food and Drugs: Extracts from the Annual Report of the Ministry of Health for 1934–35 and Abstract of Reports of Public Analysts for the Year 1934. Pp. 15 (London: H.M. Stationery Office.) 3*d*. net.

Other Countries

Smithsonian Miscellaneous Collections. Vol. 94, No. 6: The Abdominal Mechanisms of a Grasshopper. By R. E. Snodgrass. (Publication 3335.) Pp. ii+89. Vol. 94, No. 7: A New and Important Copepod Habitat. By Charles Branch Wilson. (Publication 3336.) Pp. ii+13. Vol. 94, No. 9: Review of the Genus *Chlænobia* Blanchard (Coleoptera. Scarabæidæ). By Edward A. Chapin. (Publication 3338.) Pp. 20. (Washington, D.C.: Smithsonian Institution.)

Bulletin of the Bingham Oceanographic Collection: Peabody Museum of Natural History, Yale University. Vol. 5, Art 1: Report on Hydrographic Observations in the Gulf of Mexico and the Adjacent Straits made during the Yale Oceanographic Expedition on the *Mabel Taylor* in 1932. By Albert Eide Parr. Pp. 93. (New Haven, Conn.: Yale University.)

Pennsylvania State College: School of Agriculture and Experiment Station. Bulletin 319: The Mineral Requirements of Milk Production; The Annual Cycle of Mineral and Nitrogen Metabolism of the Milch Cow, as affected by Alfalfa Hay, Timothy Hay, Bone Flour and Ground Limestone. By Ernest B. Forbes, with the collaboration of Alex Black, Winfred W. Braman, Donald E. H. Frear, Orme J. Kahlenberg, Frank J. McClure, Raymond E. Swift and LeRoy Voris. Pp. 152. (State College, Pa.: Pennsylvania State College.)

Illinois Biological Monographs. Vol. 13, No. 3: Evolution of Foliar Types, Dwarf Shoots and Cone Scales of Pinus; with Remarks concerning similar Structures in Related Forms. By Clifton Childress Doak. Pp. 106. (Urbana, Ill: University of Illinois.) 1.50 dollars.

Proceedings of the United States National Museum. Vol. 83, No. 2979: New West Indian Cerambycid Beetles. By W. S. Fisher. Pp. 189–210. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. The Fauna of Burnet Cave, Guadalupe Mountains, New Mexico. By C. Bertrand Schultz and Edgar B. Howard. Pp. 273–298. (Philadelphia: Academy of Natural Sciences.)

Research at the Indian Institute of Science, Bangalore, 1934–1935. Pp. 70+14 plates. (Bangalore: Indian Institute of Science.)

Canada: Department of Mines. Wood Fuel Burning Tests. By E. S. Malloch and C. E. Baltzer. (No 761.) Pp. 6. (Ottawa. King's Printer.) 10 cents. [1810

Catalogues

pH Values: What they are and How to determine Them. Fourth edition, revised and enlarged. Pp. 24. (London. The British Drug Houses, Ltd.)

Sodium Mandelate—Boots in the treatment of Urinary Infections. Pp. 4. Hepastab in the treatment of Pernicious Anaemia. Pp. 26. (Nottingham: Boots Pure Drug Co, Ltd)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3445 SATURDAY, NOVEMBER 9, 1935 Vol. 136

Science and Political Responsibility

AS these pages pass through the press and come to the hands of our readers, Great Britain once more lies under the stress of one of those periodically recurring emotional crises in which the future policy of government of the country for a period of greater or lesser duration is determined by popular vote. The gravity of the issues involved on this occasion needs no stress; but it may well raise the question whether the machinery of democratic government is such as to adapt itself to that scientific approach to the solution of the problems of government and administration, which the course of events in the last ten or fifteen years has shown to be a necessity of this modern age. In the hundred years which have elapsed since the introduction of the Reform Bill, thanks in great measure to the British political genius for compromise, the ultimate control of the destinies of the nation has passed from what was virtually an oligarchy to the people as a whole without the more violent pangs which marked the birth of democracy in less fortunate conditions. No longer, however, is the electorate confronted with the relatively simple issues of 'party'. The problem of the future in an increasing degree must be the manner in which, and at what stage, the scientific and technical considerations, which it would seem must enter more and more largely into the shaping of public action, are to be brought home to democracy.

John Stuart Mill, with the characteristic optimism which underlay the logical exactitudes of the Philosophic Radicals, declared that the individual exercise of the franchise was to be preferred to all the advantages that might accrue from the most benevolent despotism; and the nineteenth century, also holding to the belief in the ultimate perfectibility of the individual through education, elected to follow him. The Great War struck the final blow at the barriers, comparatively few as they were, which still stood in the way of equality of status and opportunity for all. Of these the most formidable, perhaps, was the inequality of the position of women. By the irony of circumstances, however, that great upheaval also destroyed the conditions in which these opportunities were to come to fruition. The War revealed the enormous forces which it was possible to set in motion and direct to a given end by organisation, especially on a national basis, and the complexity of the problems arising from day to day, which could no longer be localised and isolated, but were liable to affect the whole world, even to its remotest parts, through the speeding up and improvement of communication and transport.

The optimism of the post-War period of reconstruction was short-lived. The stability of civilisation had suffered a shattering blow; and throughout the world it was apparent that it was no longer possible to meet the issue by the traditional methods of party politics. The situation called for measures that were at once more drastic and more flexible, if the methods of science were to be applied to the problems of government. Action, when once a logical conclusion had been attained, was not a matter for further debate.

Even now it is too early to pass judgment on the means, some of them drastic, which have been adopted to cope with the crisis, and are still in some measure on their trial. The extended application of the results of scientific research in every field of production to meet human needs—this, too, has given rise to problems all its own—and the more highly organised methods of industry and commerce in the pursuit of efficiency and the

elimination of waste, have led by analogy to the concept of the corporate State, highly organised on scientific lines as a unit, bringing with it the inevitable consequence of the institution of a dictator as a condition of success, whether that dictatorship were held by an individual, as in Italy and Germany, with limitations as in the United States of America, or more or less in commission as in the early stages of the National Government in Great Britain, or, in theory, in Russia.

The outcome, as is familiar to all, through the repercussion of economic and political factors, has been the intensive cultivation of the national spirit, to which concessions were made at the close of the War in the interests of justice and peace, but which has now become a source of irritation and danger greater than the injustices which it was fostered to remove. To the justification of political and economic exclusiveness has now been added the doctrine of race, with the implication of racial superiority and inferiority, which in Germany has been made the basis of internal policy to subserve the purpose of commercial and economic rivalry between Jew and Christian, and in the United States has served as an argument in favour of discriminatory laws regulating immigration and imposing disabilities on certain classes of the population in social legislation.

If, however, exclusive nationalism claims to base itself upon a scientific racial theory, over against it must be set the movement towards internationalism, which has found material expression in the League of Nations. If, according to the one school, the nation is regarded as one stage in what is claimed to be a Darwinian struggle for existence, in the view of the other, it represents a phase from which we are said to be on the point of emerging in an evolution of the social organism in an ascending scale of complexity, which begins with the family, passes to the tribe and will culminate in some form of great commonwealth vast enough and elastic enough to embrace the whole of mankind.

If those who claim to speak with the authority of science may voice views so widely divergent, the puzzled layman may well ask where in all this controversy does science itself stand. Now science as such is not concerned with 'moral values', which in the long run determine the policy of the statesman, but with truth; and the man of science, as such and apart from his standing as a citizen, has no special claim to speak on the issues of political controversy, except in so far as his standing and the interests of his pursuits are affected as constituent elements of the community. When, however, the name and principles of science are invoked in support of political policy, it is to the interests of himself and of science in general—and indeed it is his duty—to examine and test the theories which have been invoked and their application, and to see not merely that they are correctly stated in accordance with the facts, but also that in their application they have not been distorted to fit the views of the partisan.

A lesson as to the true function of the man of science in relation to political controversy may perhaps be drawn from two recent publications dealing with the theories and practice of anthropological science. Of these one, "We Europeans" by Dr. Julian Huxley and Dr. A. C. Haddon, is the subject of notice in another column of this issue of NATURE (see page 736), but it may be pointed out here that in this book the authors have effectually pricked the bubble of 'race' as applied in justification of the nationalism rampant in Europe to-day. They track down the 'Aryan Race' theory to its origin in a misinterpretation—it might indeed be said a perversion—of ethnological theory, and finally cut away the ground from under 'racial' theory by demonstrating that, when examined in the light of modern methods and modern doctrines of genetic studies, race becomes virtually a meaningless expression.

In the second of these publications*—an excellent review by Mr. Penniman of the history of anthropological thought from its beginnings with the investigations of Herodotus down to the present day—the racial fallacy is traced to its origins in the writings of de Gobineau and others in the last century. It is instructive to note how, from the earliest times and long before anthropology had become an organised discipline, philosophers and political thinkers were drawing from the more or less systematic observations of travellers and historians the formularies upon which to base theories of the political and ethical ends of man.

At present, the trend of events is that the statesman must rely, in an increasing degree, on the findings of science in the interests of good government. If freedom and democracy are to endure, this constrains the man of science to hold a watching brief, lest the name of science be taken in vain and the power of the franchise abused in an uninstructed electorate.

* A Hundred Years of Anthropology. By T. K. Penniman. (Duckworth's 100 Years Series.) Pp. 400. (London: Gerald Duckworth and Co., Ltd., 1935.) 15s. net.

Industrial Reorganisation and International Obligations

The Next Five Years: an Essay in Political Agreement
Pp. xvi+320. (London: Macmillan and Co., Ltd., 1935.) 5*s*. net.

LAST year two manifestos appeared in the Press under the title "Liberty and Democratic Leadership". They represented in effect the expression of large schools of thought in all political parties of their abhorrence of *il-liberal* and undemocratic forms of government, and their determination to solve present-day problems by methods of persuasion and without curtailment of liberty. Not content with mere manifestos of good intentions, a number of the signatories have now published this book which, they claim, presents a far-reaching but attainable programme of action for the next five years. Apparently, the signatories would welcome the formation of another National Government, the centre of gravity being nearer the left-centre than the one we have known since 1931. As to how this coalition is to be brought about, the book is silent. Be that as it may, it will be welcomed in all quarters as a successful attempt to display the vast agreement which exists as to the programmes that are necessary for the organisation of a world order freed from the menace of war, the development of an economic system freed from poverty and unemployment, the safeguarding of political liberty and the revitalisation of democratic government.

In the economic sphere, a Cabinet Planning Committee is advocated of ministers without portfolio aided by an Economic General Staff composed of the best brains in the ranks of industrialists, financiers, trades unionists and experts to survey the resources of Great Britain and recommend the reorganisation of our industries to meet present-day needs. The authors set great store on the increase of our export trade, and this they believe to be possible by our participation in the formation of a 'low-tariff club'. By this means, they maintain, it will be possible in five years to return to the 1929 level of trade and thus reduce the number of unemployed by about a million. They also attach considerable importance to the inauguration of large schemes of public works, including housing, road construction and the electrification of suburban railways, as an immediate method of coping with the problem.

In view of the present international crisis, however, the reader will probably turn first to the four excellent chapters dealing with international relations. In a well-reasoned statement, the authors reject the policies of armed isolation, balance of power and alliances as being impracticable or dangerous, or both, and pin their faith to the collective system based on the Covenant of the League of Nations as the only sure method of achieving a lasting peace

It is emphasised that peace can only be secured if international anarchy is replaced by law and order, and furthermore that if peace is to be lasting, the state of law and order from which it results must be founded not on the *status quo* as it exists at any one time, but on justice. The prime necessity for the observance of international obligations is recognised and for sanctions to enforce those obligations, and also the necessity for adequate machinery for the peaceful settlement of disputes and the revision of the law to meet new conditions.

First, then, as to sanctions: it is agreed that they are morally justifiable, "used solely to prevent or put a stop to breaches of the peace with the minimum of lasting injury". Further, they are politically necessary and desirable if collective security is to be made effective. But to do this, sanctions must possess three essential qualities. "They must be *predicable* enough to serve as a deterrent to a would-be aggressor and as an assurance to those in fear of attack". "They must be *potent* enough to stop the peace breaker, surely, quickly and with a minimum of lasting injury". "They must be so conditioned and *limited* as not to impose an intolerable burden upon those who have to contribute to them".

At the present time, the sanctions on which international law depends fall far short of these requirements. They are not predicable because they depend for their use on the whims and vagaries of national Governments. Would Italy have attacked Abyssinia if she had known for a certainty that she would have to resist the moral, economic and physical strength of the combined nations in the League?

The question still remains, How are sanctions to be organised so as to fulfil these conditions? There is only one answer. The League itself should be endowed with an International Police Force. That is the key to the problem of sanctions. It is also the key to the problem of security and therefore of disarmament. Indeed, the authors recognise that if military aviation and the menace of aerial bombardment are to be abolished, it may be necessary to establish an

international air police force. The dangers of rearmament which Europe is to encounter during the next five years may yet convince even the most reactionary of us that it is only by transferring force from national control and placing it at the disposal of international justice that peace can be preserved.

The authors recognise "that provision for peaceful change of the status quo is indispensable". "The society of nations, like society within a nation, must find peaceful means of adjusting conflicts between rigid law and the changing needs and conceptions of justice". They recognise the need for a settlement of Hungary's territorial claims, of Japan's case for expansion, of some alterations with regard to Danzig and the Polish Corridor. War, or the threat of war, is the very worst instrument for settling such disputes or affecting such changes.

The authors do not consider that the Permanent Court at The Hague is a suitable body for deciding political, as distinct from legal, issues. "The most radical method is, of course, for states to entrust to an international authority the task of giving a binding decision not simply on the basis of existing law but on broad grounds of equity and balance of advantage"; and for this purpose they recommend the appointment of *ad hoc* commissions to deal with such questions.

This marks a great advance. It is a step towards endowing the League with a permanent tribunal in equity composed of men who by their uprightness, character and disinterestedness are capable of giving a just and impartial decision as between the disputants and in consonance with the interests of the international community as a whole.

These are undoubtedly the necessary instruments of the reign of law—a court and a policeman. When the League is so equipped, the world will enter upon an era of just and lasting peace such as it has never enjoyed in the past.

DAVIES.

The Racial Myth

We Europeans:
a Survey of 'Racial' Problems. By Dr. Julian S. Huxley and Dr. A. C. Haddon. With a Chapter on Europe Overseas, by Prof. A. M. Carr-Saunders. Pp. 299 + 4 plates. (London and Toronto: Jonathan Cape, Ltd., 1935.) 8*s*. 6*d*. net.

THIS book, the result of a happy collaboration, comes as an opportune prophylactic against the spreading virus of racialism. Its nine chapters contain a historical survey of the development of anthropology and racial ideas, a simple but sufficient account of human genetics, an examination of the bases and follies of ethnic classification, a review of European ethnic groups considered broadly and nationally, a careful demographic summary of European emigration and a recapitulation of the practical applications of the inquiry.

Its uniform excellence leaves little room for criticism, but the chapter on the "Ethnic Composition of European Nations" could have been improved by more systematic treatment; and that by Prof. Carr-Saunders creates the unfortunate impression that Australia, New Zealand and North America form a series of overseas Europes, practically untouched by other immigrant and endemic mores and genes. Yet the North American population, regarded as a whole, is somewhat obviously Eur-Afro-Asiatic, and one fails to follow the curious argument that the indigenes of these areas can be "disregarded" as they "have played no part in the building up of the communities which now inhabit" them.

The main utility of the book is that it demonstrates with incontrovertible clarity (and it is a reflection on human sanity that such demonstration should still be necessary) that the racial concept is a myth, and *race* "a pseudo-scientific rather than a scientific term". It has been so extensively used "to rationalize emotion, and to bolster up the appeals of prejudice" that the authors employ the expression *ethnic groups*, an advance on Prof. Boas's proposal to substitute 'populations' for 'race'. Of course, all this has been said before, but it bears saying again; and it is to be hoped that it will have a restrictive effect on the growth of ethnomania and proposals to elevate the primary, phenotypic divisions of mankind to specific rank. A large section of exploited humanity should be grateful to Drs. Huxley and Haddon for helping to deprive this prospective taxonomic exuberance of any semblance of biological foundations. For even its limited acceptance would help to relegate the Negro, already regarded by numerous morons as 'subhuman', to the category of the gorilla in the Western mind; and it would stimulate a revitalised outbreak of social ineptitude.

Other fallacies associated with racial mythology are also exposed, such as Nordic superiority,

measurable differences in innate group ability, the biological evils of miscegenation, and the equation of 'race' with 'nation', which Sir Arthur Keith is still fond of emphasising from his sylvan retreat at Downe. "The idea," they write, "of a British, a French, a German or an Italian 'race' is a political fiction, and a dangerous one at that".

In dealing with miscegenation, however, the authors express themselves 'cautiously'. They say, boldly enough, that supposedly biological reasoning against ethnic mixture is a cloak for aggrandisement and discrimination; they show, with significant lack of emphasis, that the unfortunate characteristics so often observed in 'hybrids' are associated with economic, social and cultural factors of which prejudice is perhaps the most effective; they almost follow Mr. Bernard Shaw in the timid statement that from "a purely biological standpoint it might conceivably be a good thing to undertake mass crossing between say the British and the Bantu . . ." One expects the obvious conclusion that a rational attitude towards miscegenation would be concerned with the improvement of the factors affecting it, rather than egocentric attempts to prevent relations which have proved to be unpreventable at least since the late palæolithic period. For social ills there are social remedies—and one must presume that white groups are educable. But we are informed that 'It may well be that in many cases the discouragement of 'racial crossing' may be the correct policy". It rather seems as if Dr. Huxley suddenly remembered the manifesto of the Eugenics Society and his position on its council, but it comes too late to be really effective; and a single lapse from the "appeal to fact" is surely excusable in a book otherwise so attractively radical.

CEDRIC DOVER.

Scientific Study of Place-Names

The Place-Names of Essex
By P. H. Reaney. (English Place-Name Society, Vol. 12.) Pp. lxii+698. (Cambridge: At the University Press, 1935.) 25*s*. net.

ESSEX is generally reputed to be the one county of England which has best preserved among its peasantry the traditional outlook of an earlier day, just as its buildings are richer in characteristic examples of early styles of domestic architecture. The impression of a certain remoteness which compels attention outside the urban areas is intensified by a flavour, an archaic quality, in the names of its smaller towns and villages, which seem to recall more insistently than elsewhere a countryside which was part of a social order based on church and manor very different from that of the twentieth century.

Even when every tangible evidence of antiquity has vanished before the advance of suburban London, the names remain. Stratford—not the "Stratford-atte-Bowe", which lies across the river in Middlesex—still marks where the Roman street crosses the river, although its neighbour Leyton is no longer, at the request of its mid-nineteenth century inhabitants, the "Low'tun on the Lea"; and it comes as something of a surprise that names so familiar to the suburban as Chingford and Billericay have an antiquity which has left no trace of their derivation.

It is one of the functions of inquiry pursued in the scientific spirit to confirm or destroy impressions. The volume of the Place-Name Society which deals with the county of Essex brings together an imposing array of current names—to say nothing of those no longer in use—of a more than respectable antiquity. They point to a general continuity of long tradition throughout the county area which here and there, in names that defy etymological analysis, may stretch beyond the bounds of recorded history.

Of the Celts, notwithstanding the seat of the great British kingdom at Colchester, there are few traces—names such as Camulodunum itself, Colne, Lea, Pant, Stour and a few others of Celtic origin, as well as names imposed from outside, such as Walton or Walden, "the wood of the serfs", or more probably, "the Britons". Early political or geographical conditions may be responsible. It does not necessarily follow that the earlier inhabitants were completely evicted by the East Saxons, whose kingdom, with its capital in London, embraced the modern county and Middlesex as well. From these East Saxon settlers and their descendants the majority of Essex place-names are derived, memories of the Roman occupation appearing in Colchester, Chesterton and others now no longer in use. On these Saxon names is superimposed a stratification of racial and social history in names of Scandinavian, Norman-French, French and English origins, in which descriptive, locative or functional elements are embodied, as well as derivatives from personal and family names.

Exposed as the county was to entry from the sea by way of its many creeks and estuaries, as the Saxon settlement had shown, it was inevitably raided by Scandinavians; but they do not seem to have been disposed to settle as they had farther north. Scandinavian derivations are not common, though they are seen in such names as Audley End, Kirby, Skighaugh and, more doubtfully, in Clacton, Thorpe-le-Soken and Frowick. No county, however, shows more strongly the effect of the Norman invasion. Many names derive from feudal and manorial custom, or are survivals of the personal and family names of barons of the county, such as Grays from Henry de Grey, its baron in 1194, Helion Bumpstead, Hadfield Peverell or Woodham Ferrers. Names that are of purely French derivation, such as Pleshey and Beaumont, are relatively not infrequent.

However great the interest to the historian of the later evidences of the growth and organisation of society which have been collected by students of Essex place-names, the archæologist will return again and again to the indications of great age and of early settlement to be found in county nomenclature. In evidence of both these Essex is especially rich. As the distribution of the earliest forms, those ending in *ge* and *ingas*, would show, the earliest Saxon settlements were along the estuaries and river-valleys, Thames, Lea, Blackwater, Crouch and Colne, as well as along the coast, now marshy, but then more attractive, with a tidal level thirteen feet lower than it is to-day. To this group belong such settlements as Firminghoe at the mouth of the Colne and Dengee on the coast between the Blackwater and the Crouch. Later, from these isolated settlements they spread along the Roman roads and to the less easily worked lands, and to woodland clearings which they at first had avoided, until settlement was general throughout the county. It is significant that it is in the wooded areas, and especially towards the heavy soils of the north-west, that the Saxon names are latest in form and that traces of the survival of a Celtic element are found.

Of paganism there is evidence in the worship of Thunor and Woden which appears in Thundersley and the lost Thunderlow and Wodnesfeld in Widdington. High Ongar and Little Wakering were probably once places of worship, while in Broxted and Hertisheued in Lindsell there is suggestion of heathen sacrifice. The familiar Teutonic water-sprite is responsible for Nickerlands in Stanford Rivers and Nickersmadwe in Greenstead by Colchester. The general distribution of these and similar names points to a widespread settlement of the county area while paganism still flourished.

The attention given to the names of fields in recent volumes of this series has been carried further in the study of Essex. In the long list given here much information may be gleaned bearing on social and economic conditions. Of such, for example, are names which point to the dedication of certain fields to specific services of the church, or the presentation of land to the bride on the morning after the wedding.

The publications of the Place-Name Society go from strength to strength, and the Essex volume is an advance on a standard already high. It is recognised how much of the excellence of the volume is indebted to the labours of such great scholars as the late J. H. Round and R. C. Fowler. It affords a technical equipment, including an excellent series of distribution maps, which will be of the greatest assistance to further research.

Parasitism and Disease

By Theobald Smith. (Published on the Louis Clark Vanuxem Foundation.) Pp. xiii + 196. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1934.) 9*s*. net.

IN these lectures the late Prof. Theobald Smith reviewed the knowledge and experience of nearly fifty years of fruitful devotion to research on infective disease in man and animals. The book contains an analysis of the complex interactions of host and parasite and a commentary on the very varied aspects of the subject. Starting with the maxim that the most effective factor in the evolution of parasitism is the continued life of the host, the writer maintains the thesis that parasitic diseases have begun by the straying of the invader into a new tissue or animal, where it may be at once destroyed or may set up an unwonted cycle with serious consequences for the host; after this phase and perhaps after many such attempts, a new recurring disease may be started, and finally a mutual tolerance established with little inconvenience to host or parasite, and so the continuance of both attained. The four essential stages of parasitism are laid down as entrance of the parasite, multiplication in the new environment, exit and transit to fresh hosts. The modifying influence of host on parasite and the converse, and the origin of races of parasites peculiar to special hosts are discussed.

The author derives the need for active public health measures from the axiom that Nature abhors a crowd and reduces superabundance by disease, but he points out that freedom from disease exacts the price of constant vigilance and readiness to use new tactics to avert renewed attacks in the constantly changing ecology.

The book is full of interest to all biologists as well as to medical men and veterinarians, for the matters discussed have been passed through the mind of a master who had no small share in the original observations and in their elaboration.

Faraday's Diary:
being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820–1862 and bequeathed by him to the Royal Institution of Great Britain, Now, by order of the Managers, printed and published for the first time, under the editorial supervision of Thomas Martin. Vol. 6: Nov. 11, 1851–Nov. 5, 1855. Pp. xiv+495+8 plates. (London: G. Bell and Sons, Ltd., 1935.) 7 vols., £12 12*s*. net.

THIS, the penultimate volume of Faraday's Diary, covers the period from November 1851 to November 1855. In the main, the topics treated are lines of magnetic force, the construction of a magnetic torsion balance and the measurements made therewith, electrodynamic induction in liquids and magnecrystallic action. The MS. of this section of the Diary is noteworthy as containing a number of "the actual specimens prepared by Faraday in 1851 to illustrate the delineation of lines of magnetic force by iron filings. The filings were fixed on cartridge paper by means of gum water, sometimes mixed with a solution of 'the red ferro-prussiate of potassa' (apparently potassium *ferri*cyanide), which was found to leave a blue impression of the pattern after the filings had been removed or worn off". A number of the specimens have survived the changes of more than eighty years, and this volume contains collotype reproductions of some of the more suitable specimens. The frontispiece is a reproduction of the famous painting which represents Faraday giving the Christmas lectures of 1855–56 before the Prince Consort, the Prince of Wales and Prince Alfred.

The volume maintains the interest of its predecessors. Detailed consideration of its contents is deferred until the appearance of the concluding volume, when opportunity will be taken to discuss the whole work. A. F.

Die Blutsverwandschaft im Volk und in der Familie:
ein Beitrag zur menschlichen Lebenskunde (Anthropologie). Von Dr. Walther Jankowsky. Pp. viii+166+12 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1934.) 6 gold marks.

DR. JANKOWSKY here enters upon an investigation of no little general interest, as well as of importance in the present standing of racial studies and the question of human inheritance. His central problem is that of resemblances in appearance, both as between members of a family and as between individuals who are not known to be personally related. He also brings into consideration the biological character and significance of such phenomena of resemblance. He discusses successively the concepts of blood relationship, resemblance factors, individual heredity and pseudo-resemblances. Further, he examines and sets out the methods of investigation applicable to the investigation of the specific problem. One of the most important aspects of the question, on which his views will be found of no little interest to the ethnologist and the student of human heredity, is that of the degree to which significance is to be attached to resemblances without personal relationship in the light of the theory of chance and with special reference to the conditions of descent within a given population.

Dr. Jankowsky's cautious conclusions and well-marshalled arguments, in what is admittedly an obscure field, will serve as a useful corrective of over-hasty generalisations which too frequently go beyond what a scientific interpretation of the evidence would admit.

Anorganisch Chemisches Praktikum:
für Studierende der Chemie und anderer Naturwissenschaftlicher Facher. Von Prof. Dr. Wilhelm Manchot. Pp. viii+103. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 4.30 gold marks.

THIS course, by one who has made important contributions to inorganic chemistry, is based on the axiom that a student of chemistry should be given the opportunity of becoming acquainted with the appearance and reactions of as many materials as he can in the time available, since this opportunity may never be available in his later career. By combining a course on qualitative analysis with preparative experiments he has attempted to provide a wider basis of instruction, and since this course has been followed in his own institution at Munich, it is obviously a possible one. The order seems at first sight unusual, since experiments on potassium compounds, for example, are followed by halogens, these by silica and silicates, and hydrogen peroxide comes between oxyacids of sulphur and the oxides of nitrogen. Whilst this arrangement may have some advantages as proceeding from less to more difficult experiments, it would seem to conflict with the usual order of lecture courses and would probably not be found satisfactory in English universities.

The Socialization of the Electrical Supply Industry
By G. H. (Published for the New Fabian Research Bureau.) Pp. 104. (London: Victor Gollancz, Ltd., 1934.) 3*s*. 6*d*. net.

THIS survey of the electric supply industry is published under the auspices of the New Fabian Research Bureau, but the author alone is responsible for the views expressed. The conclusions are substantially in agreement with those in the Labour Party Policy Report No. 3. The ownership of local authority and company undertakings will be transferred to a reconstituted Central Electricity Board. The Central Electricity Board would issue new bonds secured on the revenue from the whole supply industry of the country in payment for the ownership. Difficulties in the way of doing this are clearly explained. Similar difficulties will arise in the socialisation of all industries. The present average yield on electric lighting shares is about 4 per cent; this would be replaced by redeemable bonds giving 3½ per cent and so the capital charges would be reduced by about 12 per cent. The advantages of mutual co-operation between gas and electricity supply are pointed out. One advantage of railway electrification would be to cheapen the cost of supply from the grid. The book is well written and free from dogmatism.

The Psychological Approach to the Problem of Road Accidents*

By Dr. Charles S. Myers, C.B.E., F.R.S.,
Principal of the National Institute of Industrial Psychology

IT is well recognised that the problem of road accidents may be approached from various aspects, for example, the statistical and the engineering aspects. In this paper I consider the approach made by the psychologist—whose special training should render him expert in considering and advising on the part played by 'the human factor' which, it has been estimated, enters into eighty to ninety per cent of road accidents.

The psychologist cannot, of course, neglect the value of statistical data; indeed he is bound frequently to use them. Nor is he by any means unconcerned with engineering and other similar mechanical factors. But all these must be his servants rather than his masters; he has to regard them in their subservient relation to his psychological and physiological knowledge—his knowledge of the living mind and body.

Many statistical data, for example, appear to the psychologist as vitiated, if not valueless, because they have been collected and treated without the foresight of pitfalls, and without the care in framing questions, which would have been employed by one trained in psychological experiment and in psycho-physical methods.

So, too, the merely mechanical perfection, say, of car signals and of car controls (levers and pedals) does not content the psychologist. He would institute an inquiry into which of their manifold forms and positions best and least satisfy the human requirements of the driver or pedestrian; no such investigation has yet been made, at all events in Great Britain.

Or again, while recognising the proved value of traffic signals, the psychologist would ascertain their best mode, form, height, etc., again in relation to the human factor in their percipients. For example, it would be easy for him to overcome the dangers of defective colour-vision among road users by instituting differences in shape of the red and green traffic signals, and it appears to him worth while to investigate the problem whether the present system of unwarned changes from one colour signal to another is not deserving of improvement.

In regard to the lights of roads and cars, the psychologist is not content with the desirability of merely increasing their intensity: his familiarity with the physiology of vision compels him also to take into expert consideration the dangers of contrast, shadows, glare and the like, and individual differences in speed of adaptation to sudden gross changes in illumination.

The various traffic regulations—in respect of direction, speed and signals—are each, doubtless, individually justifiable, when based on scientific experimental evidence. The psychologist would, however, also investigate the combined, total effect of these various regulations on the driver. Is there no danger of their becoming so numerous as to impose excessive strain on his attention by increasing his distraction, and thus to enhance his liability to accident? May they not also so seriously affect his peace of mind that, when he escapes from their zone into less crowded thoroughfares, he tends immediately, in his irritation, to reckless driving and again to enhanced liability to accident?

The psychologist fully recognises the value of incentives and deterrents—rewards and punishments—in promoting good behaviour, but experiment and experience have taught him much concerning the value of their various forms; and it is becoming increasingly recognised that his help should be invoked to determine whether or not an offender deserves to be wholly or partly excused from punishment or to receive other forms of treatment. This help is rendered by the psychologist not merely by inquiries into the conscious and unconscious mental and bodily make-up of the offender; he must also investigate the remote, as well as the direct, causes of the accident—the effects of predisposing previous strain, fatigue, worry and irritation, and of such drugs as alcohol. He would also ask to be allowed to extend his inquiries into dangerous behaviour on the part of road users which might have resulted, although it did not actually result, in accident; and he must be in a position to recognise the mental and physical abilities and the temperamental qualities required for a safe driver, to assess those abilities and qualities, and to assert whether a driver possesses them in adequate measure for him to follow with fair safety his unquestionably dangerous occupation or amusement. Finally, he should be allowed to advise the prospective or the inefficient driver as to those of his defects, revealed by psychological tests, which might be improved by special training.

* A paper at a joint discussion in Sections G (Engineering) and J (Psychology) of the British Association read at Norwich on September 10, 1935.

At present, motor drivers are selected merely on the basis (*a*) of freedom from gross physical disabilities, (*b*) of their knowledge of traffic regulations and signals, and (*c*) of their ability properly to start, stop, turn and reverse their vehicle, and to overtake, meet or cross the path of other vehicles. At present about eleven per cent of the applicants for car licences fail in this examination. But it will be at once recognised that, like most other examinations, this is one that can be passed by unsatisfactory people after sufficient 'cramming' and repeated entry, and that it is not an adequate test of the qualifications required for a really safe driver.

There can be no doubt that certain people are more liable to accidents than others. Some psychologists have assumed that there exists in various degrees among mankind one and the same *general* liability to accidents, whatever be the employment or activity in which accidents may occur. Acting on this hypothesis, the Industrial Health Research Board has devised a series of tests which have been uniformly applied to fitters, plumbers, carpenters, engineers, as well as to the drivers of certain public vehicles, with the ultimate object of eliminating those who are most liable to accidents in these various occupations. These tests are, generally and broadly, tests of the accuracy and speed of hand-and-eye co-ordination; and, as might be expected, the scores obtained from them prove to be closely related to manual and mechanical efficiency. Undoubtedly the ablest workers sustain the fewest accidents; but it seems also that there really exists in every individual in a certain degree a general susceptibility to the very different kinds of accidents that may occur in widely different occupations.

Nevertheless, those who have had the most experience in vocational selection have come to place greater reliance on tests which have been devised after a special study of the conditions and requirements of the particular occupation to which they will be applied. It is therefore also a possible, and it may well be a more promising, line of research to study the special qualities required for the successful avoidance of accidents in any one particular occupation and then to devise methods for the assessment of those qualities in that occupation. This has been the method adopted by the National Institute of Industrial Psychology in regard to the selection of car drivers.

In any event, before applying them to new applicants, the psychologist will test his tests by applying them to drivers good, bad and indifferent, in order to ascertain the correlation between the scores made by them at the tests and the known frequency of their accidents on the road. This correlation reaches a satisfactory degree in the case of the Institute's methods.

The motor-driving tests which have been devised and installed at the National Institute of Industrial Psychology assess separately—speed of appropriate reaction to a given signal, resistance to distraction, the ability to 'attend to several things at once', vision, judgment of size and speed, and also self-confidence, road behaviour and manipulative ability. Although no single mental test, whatever its nature, can ever be absolutely infallible, together these tests appear to afford a sufficiently reliable criterion of driving ability. They assess certain important, innate qualities, of which some will doubtless appreciably improve with practice, but others of which are not susceptible of such obvious improvement. They do not pretend to determine that a driver who passes them satisfactorily will never be prone to reckless conduct; but they do claim to select those drivers who possess the necessary abilities to extricate themselves from a dangerous situation when it confronts them; in other words, such tests when applied to the selection of drivers do reduce their liability to accident. Similar tests applied to drivers in the Paris omnibus service have, according to the most recent data published, reduced the accidents to these vehicles by 66 per cent between the years 1929 and 1933, although the number of omnibuses had meanwhile increased by 77 per cent and their speed limit by 44·5 per cent. During the same period, the total number of motor-vehicles in Paris increased by only 35 per cent, but their accident rate *increased* by 5 per cent. This difference has been attributed to the use of selection tests. No comparable data are available in Great Britain. But it is noteworthy that in the Metropolitan Police District of London, between April and the first half of August of this year, the total number of persons killed and injured from all road accidents was reduced only by about 9 per cent, as compared with the same period during the previous year; while the number of licensed motor vehicles throughout Great Britain increased by about 7 per cent.

If the application of such selective tests results occasionally in the exclusion of good drivers, whether public or private, some hardship must be incurred individually. But surely from the point of view of the community, it is far better to inflict occasional hardships on the individual than to admit by our present far less efficient methods of selection, those who will afterwards reveal their unsuitability as drivers by injuring or killing their fellow-citizens. Even if public opinion is not ready to concede this, these tests will still undoubtedly prove helpful in the case of 'border-line' entrants to the Ministry of Transport's examination, in

confirming the unfitness to drive of those whose conduct has resulted in threatened or actual accidents, or in indicating what is amiss in them and what may be amenable to correction. They will also prove useful in selecting the best applicants for driving public vehicles and vehicles owned by commercial or industrial companies.

If stringent selection is impossible, and if proper mechanical safeguards have been introduced, training is the next most important prevention against accidents. Clearly, the pedestrian and the bicyclist cannot be selected; it is therefore essential that they, above all others, should receive instruction how to avoid accidents from motor traffic. There is one truth which the experienced industrial psychologist never tires of asserting, that no one should be permitted to pick up his methods as best he can—not even the road user! Systematic training is essential for all road users, including the car driver. Yet at present no systematic training is required even from the latter.

A still wider problem of psychological importance relates to the most effective forms of propaganda and of appeal to the public for the improvement of road behaviour. The methods devised by the industrial psychologist in market research would prove of great value here. These methods have hitherto been employed to save the waste of time, effort and expense which is so often incurred when the psychologically untrained industrialist places an advertisement or a new design or package of goods in the market in the mere *belief* that it will be commercially successful. Market research consists in ascertaining systematically and directly what the general public desires and prefers, and in ascertaining the differences in desire and preference due to sex, age, social level, etc. Experience in such market research has enabled the industrial psychologist to avoid various pitfalls which await the inexpert, untrained person. If his methods were applied to the discovery from all angles of the most attractive, least resented forms of propaganda and appeal to the general public in regard to the avoidance of dangers on the road, this would prove to be yet another psychological approach to the problem of road accidents.

Thus there are many ways in which the special abilities and training of the applied psychologist can be utilised—in the design of traffic and car signals and car controls, in the nature and multiplicity of traffic regulations, in the illumination of roads and vehicles, in incentives, propaganda and instruction of road users, in inquiries into accidents and defective road conduct, and in the selection and rejection of drivers.

Progress in the Gas Industry

PEOPLE are so accustomed to having gas on tap, requiring only the aid of a match to give them heat or light, that they are prone to forget the gas industry is a progressive one, continually improving on the production side, in quality of product and in the efficiency and adaptability of the apparatus used to burn it. It is a proud boast of the industry that gas excels all other public services in reliability.

In this Jubilee year it is appropriate to summarise the developments throughout the industry during a quarter of a century: this has been happily done in the summer number of *West's Gas Journal*, which contains articles by several leading experts in the various sections of gas engineering. A brief epitome of the developments should be of interest to a wider public, since coal and its carbonisation form one of the major problems of Great Britain. The use of raw coal in the domestic grate and many other appliances, including the factory boiler and furnace, has been condemned for years, and a prior treatment advocated to recover the volatile constituents leaving the smokeless fuel—coke—for burning. The old customs die but slowly though there now appears to be an acceleration in the disuse of raw coal, judging particularly from the statistics of railway traffic.

Gas is made by carbonising coal in horizontal or vertical retorts or in large chambers. In 1910 vertical retorts were newly introduced; they have since made great strides. The methods of charging the coal and discharging the coke have been greatly improved, as also the manner and economy of heating the retort settings. As a consequence, the number of gaseous therms per ton of coal carbonised has considerably increased.

Since the Gas Regulation Act of 1920, gas has been sold on a declared calorific value and charged for by the therm instead of by volume, though it is this which is actually measured by the meters. The London undertakings have tended to keep a higher calorific value (of 500 B.T.U.) than the provinces, in part owing to the necessity of getting a higher duty out of their distribution mains. It is desirable to emphasise that the great gas companies send out a gas of constant heating value, at a constant pressure, of a constant density and low in sulphur, so that it burns in suitable apparatus

without any regulation. Coke at one time was regarded as a by-product and its quality varied accordingly; to-day it is standardised as carefully as is gas and distributed graded as to size, ash content and burning capacity, so that it requires a minimum of supervision when burnt in closed stoves. A great amount of scientific work has been applied to realise these high standards of quality of gas and coke, and the achievement is no mean one. The penetration of the chemist into the gas industry largely coincides with the Jubilee period: he is being regarded more and more as one of the key men in the industry and there are not wanting those who regard its future as largely on the chemical side.

The gas engineer continues to develop improvements in detail and to organise gas matters on a larger scale, including carbonising, purification and distribution. Condensing practice has changed in favour of the horizontal tube form of welded steel construction, electric precipitation removes the last traces of tar. Centrifugal and static type washers are in use, and it has become customary to remove naphthalene and benzole by washing. Unfortunately, the ammonia recovery has received a setback owing to the fall in price due to the competition of the synthetic product. Purifying is almost exclusively done with oxide of iron, which enables the sulphur to be recovered in a marketable form; in some cases the sulphur is almost completely removed by a catalytic process, though generally this problem is still left for the future. For storage purposes, the waterless holder now competes with the old-fashioned gasometer: in Great Britain it is still in the experimental stage in regard particularly to economy of maintenance and the extra supervision required, though both on the Continent and in America it has become widely adopted.

High pressure distribution of gas has brought new problems, largely solved by the use of welded steel tubes. The introduction of spun cast iron pipes has increased their length and given a more homogeneous material than ordinary cast iron.

For a long time the output of the industry increased each year. Latterly, there has come a great change in the domestic habits of the people, and gas also has to face intense competition from other sources of light and heat. In consequence, there is an awakening to salesmanship with the provision of show-rooms. In particular, a great stimulus has been given to the improvement of gas-cookers and fires which, since 1910, have been bettered in all respects almost beyond recognition. The same applies to water heating and to the use of gas for industrial heating, a field in which there is great development taking place. Lastly, gas holds its own for street lighting, as an evening in the streets round Whitehall or in South London will testify. Here the physicist has been called into co-operation so that the maximum light can be directed along the length of the road.

This brief sketch indicates the virility of what is now an old industry, largely due to the more scientific outlook which it is showing towards its problems. There is a tendency to concentrate the industry in larger units, either by regional absorption or amalgamation of the smaller companies by the larger, or by the purchase of isolated companies by holding groups. The former plan obviously makes for greater efficiency and benefit to the consumer; the latter move is regarded with some unrest by many.

Chemotherapy of Malaria*

By Colonel S. P. James, F.R.S.

WITH the distressing effects of the malaria epidemic and famine in Ceylon still fresh in our minds, the subject of the chemotherapy of malaria may very appropriately be discussed at the present time. The area affected was not so large as Yorkshire, but the cost of relief measures was about £350,000, and during the six months from November until April, 14½ tons of quinine, costing £50,700, was used. About £20,000 was also spent on the new antimalarial remedy called atebrin. The epidemic reminded the world once again that no royal road or short cut to the prevention of malaria has yet been found. During recent years similar reminders have come from British India, Malaya, East and South Africa, Nigeria, the Sudan, Mauritius, Trinidad, Barbados and other British territories overseas. A few years ago an epidemic in British India prostrated the whole population of an area twice as big as England. The ordinary business of large cities was interrupted, no labour could be obtained, transport was disorganised, and even sellers of food ceased to carry on their trade. In one group of towns and villages the deaths during the month

* Opening of a discussion in Sections B (Chemistry) and E (Geography) of the British Association at Norwich on September 9, 1935.

of October, instead of being as in a normal year about 6,840, were 76,250.

The financial losses due to such an epidemic, or to the recent epidemic in Ceylon, are quite incalculable, but some idea of the cost of malaria is indicated by the amount of money spent in ineffectual attempts to combat it. For example, the island of Mauritius has spent more than 3½ million rupees on antimalarial measures since 1909, but the prevalence of the disease has not appreciably decreased, and local experts have recently suggested that the whole question should be studied anew with the object of discovering some less costly method of checking the scourge Lagos, the capital of Nigeria, has spent even more money with less success, for the present position is that every native inhabitant of the town above one year of age has the disease.

Perhaps the most striking examples of failure to prevent malaria by applying the teachings of existing knowledge occurred during the War. One example must suffice. In June, 1916 a British division moved forward from Salonika to occupy the valley of the Struma river in Greek Macedonia. About a fortnight after entering the valley the troops of the division began to go down with malaria at the rate of more than 100 a day. During July and August there were 5,000 cases; in the whole year there were 30,000 and the next year 70,000. A French army corps under General Sarrail held the line next to our troops. That army entered the valley 115,000 strong, but within the next few months 60,000 were down with malaria, and by the end of the year only 20,000 were left in the line. General Sarrail reported to the French Government that his army was immobilised in hospital. The German army on the same front suffered equally, but it is not difficult to picture what would have happened if either of the opposing forces in that war region had been able to keep its soldiers free from the disease.

In view of these and other examples it has to be admitted that, despite some remarkable discoveries, existing knowledge on the prevention of malaria is not sufficient. Direct war on the malaria-carrying mosquito is too difficult and too costly for general use, and quinine has failed to maintain its old reputation as the sovereign remedy which meets all needs. More knowledge is needed in many different directions, one of them being chemotherapy, in which subject British chemistry has as yet played only a very small part. This seems surprising when we reflect that, of the 3½ million deaths from malaria recorded in the world every year, the great majority occur in the British Empire, and that the British Empire alone spends every year about £450,000 on quinine.

Quinine has been in general use for nearly a hundred years, but no one knows, and scarcely anyone is trying to discover, how this remarkable natural remedy acts. Even yet its merits and defects as an antimalarial agent are very imperfectly understood, and it has been said that there are almost as many methods of treating malaria with it as there are physicians who use it. To a considerable extent it satisfies the practising physician because it promptly stops most clinical malarial attacks, but it has grave defects from the point of view of preventive medicine for it does not prevent infection of either the human host or the mosquito, and it does not prevent relapses. These defects became strikingly evident during the War, and in consequence it was realised how advantageous it would be to have antimalarial remedies which would be effective for particular purposes for which quinine is known to fail.

To discover and prepare such drugs is the chief aim and object of antimalarial chemotherapy. What is aimed at is not to supplant quinine, but to supplement it with additional weapons for use in particular circumstances and for particular purposes. In Germany, two synthetic antimalarials, plasmoquine and atebrin, which to a considerable extent fulfil that requirement, have already been discovered, and now it is hoped that Great Britain will make adequate arrangements to pursue the subject in the same intensive way and with the same objects in view. Up to the present the chemical industries of this country have not concerned themselves with the matter, and the grants which have been allotted by Government during the last few years to assist antimalarial chemotherapeutic research have amounted to less than a two hundredth part of the Empire's annual bill for quinine.

If and when adequate arrangements for antimalarial chemotherapeutic research are made in Great Britain it will, of course, be one of the tasks of the biologist to tell the chemist all that he knows of the life-history and biological properties of the various species of malaria parasite, and for what particular purposes he is desirous of being supplied with drugs that are superior to quinine. As Sir David Prain said a few years ago: "When medicine is in a position to tell chemistry exactly what medicine requires, the chemist will in due course deliver the goods". Prof. Robinson has said much the same thing in other words, so I shall now give some indications on that subject by pointing out the chief defects of quinine as an antimalarial agent, and some of the merits of atebrin and plasmoquine as additional antimalarial weapons.

The first and by far the most important defect of quinine is that it does not prevent infection:

it is not a true causal prophylactic. What we want is a drug which, taken in non-toxic doses, will entirely destroy the organisms injected by infected mosquitoes before these organisms begin to continue their developmental life-cycle in the human host. Until a few years ago quinine was thought to be effective for this purpose. It was thought that if persons in malarious places would take a dose of quinine at sunset and another at sunrise, all the germs injected by a mosquito which had bitten them during the night would be killed and they would not suffer from malaria. Clinical observations give no support to that belief. For example, the temperature chart of a person who took ten grains of quinine shortly before being bitten by mosquitoes, the same dose shortly after being bitten, and the same dose daily thereafter for ten days showed that these prophylactic doses had no effect in preventing or delaying the malarial attack. Another trial with larger doses of quinine showed the same failure. The attack occurs, even when prophylactic doses of 45 grains (3 grams) of quinine are used.

It is interesting and important that the same trials with either of the new synthetic preparations plasmoquine or atebrin give a quite different result. In a comparative trial with quinine and atebrin and plasmoquine against infections of malignant tertian malaria, all the controls who took no prophylactic drug and all those who took quinine as a prophylactic had their attack of malignant tertian malaria within the usual incubation period, but none of those who took atebrin or plasmoquine had any malarial attack.

Atebrin and plasmoquine do not work so well as true causal prophylactics against benign tertian malaria as they do against malignant tertian, but lack of time prevents my giving details on that subject. The point I wish to make is that these drugs are not simply substitutes for quinine: they are new weapons with a specific action on a phase of the parasite against which quinine has no effect.

A second defect of quinine is that it is not equally effective against all species and strains of the human malaria parasite. This defect is common to all known antimalarial remedies, and is the chief reason why it is desirable to have several drugs at disposal for treatment in order that, when one fails, another may be tried. For example, some strains of malignant tertian malaria are not at all susceptible to quinine, but are very susceptible to atebrin. On the other hand, some strains of benign tertian malaria react quicker to quinine than to atebrin, and for this reason many clinicians prefer to 'break the fever' (as they say) with quinine, and to continue later with atebrin.

A third defect of quinine is that it is not very effective in preventing the relapses which are such a troublesome feature of some cases of malaria. Here again a chief difficulty arises from the fact that different species and strains of the malaria parasite react differently to the various anti-malarial remedies at present known. In malignant tertian malaria, relapses may often be entirely prevented by treatment with atebrin instead of with quinine. On the other hand, the relapses of benign tertian malaria are much more difficult to prevent. The most important type is that which occurs about eight months after recovery from the primary attack. It is the type which causes what is called 'the spring rise of malaria' in northern Europe and other countries. It was the type responsible for the second wave of the recent malaria epidemic in Ceylon. No drug treatment yet known will prevent this type of relapse.

Lastly there is the problem of preventing the spread of malaria by what is called gametocyte therapy. Gametocytes are the forms of the malaria parasite which infect mosquitoes, and it has long been known that in malignant tertian malaria quinine is quite ineffective in preventing the infection of mosquitoes which feed upon persons suffering from this disease. Plasmoquine, on the other hand, is so effective against the gametocytes of malignant tertian malaria that doses even as small as two centigrams are sufficient to prevent mosquito infection. For this purpose, therefore, plasmoquine is a new antimalarial weapon of proved efficacy. But a further requirement in this category is a drug that will prevent the production of gametocytes in the human host and their appearance in the peripheral blood from which they are sucked into the stomach of the mosquito when it feeds on infected persons. Plasmoquine kills gametocytes *after they have been produced and have appeared in the peripheral blood*, but it does not arrest their birth and development.

From these few examples it will be evident that the epoch-making discoveries made by Prof. Schulemann and his colleagues at Elberfeld have placed in our hands new antimalarial weapons of great power and precision, but that there is still ample scope for further research in Great Britain and other countries. It is not expected, of course, that in England funds available for chemotherapy research will ever be provided on the same scale as in Germany, but the British Empire with its vast malarious territories in Africa, India and the Far East is more concerned with the provision of effective antimalarial agents than is any other group of nations in the world and, having regard to the humanitarian, economic and imperial interests at stake, it is greatly to be hoped that something will be done about it.

Obituary

General A. W. Greely

ADOLPHUS WASHINGTON GREELY, whose death was recently announced, was born in Massachusetts in 1844, and in 1867 joined the Signal Corps of the regular army. In 1881 he was placed in command of the United States expedition to Lady Franklin Bay, Smith Sound, which was one of the two American circumpolar stations in connexion with the first International Polar Year. Greely and twenty-five officers and non-commissioned officers of the United States Army, with two Eskimos, were landed at Lady Franklin Bay on August 18, 1881, and a station, named Fort Conger, was erected. The ship then departed, her commander intending to return the following summer and not expecting any difficulty in again reaching the station. Admiral Nares had taken the *Alert* farther north, off the same coast, in 1875; but these ice-infested channels are seldom navigable, as the British expedition organised by Shackleton's younger son found only last year. Scientific observations were begun, and much game, especially musk-oxen, was seen. Some of these cattle were shot, and eaten during the winter.

In 1882 Lieut. Lockwood made a sledge journey along the north of Greenland, on which he discovered and charted about 125 miles of new coastline, beyond the farthest point reached by Beaumont of the Nares Expedition. Lockwood reached the record latitude of 83° 24′ N. in long. 40° 46′ W. Greely himself made even more interesting discoveries in the interior of Ellesmere Land, including Lake Hazen, more than fifty miles long, mountains, rivers and a number of Eskimo bone instruments. The relief ship failed to arrive and a second winter had to be spent at Fort Conger, as other parties, less well supplied, have done. There were caribou as well as musk-oxen, and salmon in the Lake Hazen district.

In April 1883, Lockwood followed Greely westwards, but completely crossed Ellesmere Land to Greely Ford, where he discovered a weird and wonderful cañon country. As the ship again failed to arrive, the outlook was serious and a retreat southwards was begun on August 18. News was found that the ship had been lost. Greely's party reached Cape Sabine on October 12 with very little food, and in this district game was scarce. In November the rations were reduced to 14 oz. a man a day, and in January 1884 the first man died. Lockwood kept his meteorological record until April 7 and died two days later. On May 24 all the food was finished, except for seaweed and shrimps, though the men became too weak to procure them. One man had to be shot for stealing on June 6. The seven survivors, including Greely, were rescued on June 22.

Greely gave the results of the expedition in his "Three Years of Arctic Service" (2 vols., 1886), which is worthy of comparison with the greatest works of other explorers. Work in the Signal Corps then claimed Greely, who eventually became Major-General and Chief Signal Officer. In 1909 he published a "Handbook of Polar Discoveries", in 1912, "True Tales of Arctic Heroes", in 1927, "Reminiscences of Adventure", and the following year, "The Polar Regions in the Twentieth Century". In 1923–24 D. B. MacMillan placed a tablet on Cape Sabine in memory of the disaster; and in 1934 Greely was awarded the Congressional Medal of Honour. The Royal Geographical Society recognised his services by the award of the Founders' Medal in 1886. He was one of the founders of the American Geographical Society, to which he bequeathed his Arctic collections. Greely did excellent work in his day and set an example, not always followed, of careful and accurate detail. He was an explorer of whom the United States may well be proud. J. G. H.

Dr. F. E. Rowett

TECHNICAL education in London has suffered a great loss by the death of Dr. F. E. Rowett, principal of the North Western Polytechnic. His career is an excellent example of the use of the facilities offered by our modern educational system, for a youth having ability and perseverance, to climb the academic ladder.

Dr. Rowett was the son of Capt. J. Rowett of the Board of Trade. His early life was spent at Portsmouth, after which the family moved to Gillingham, where he attended the Wesleyan Elementary School until he entered H.M. Dockyard, Chatham, at fourteen years of age, as an engine-fitter apprentice. Besides attending the Dockyard School, he went to Gillingham Technical Institute in the evenings and eventually obtained a Whitworth exhibition. After spending one year at East London College under Prof. D. A. Low, he obtained a Whitworth scholarship, the first year of which he spent at the Royal College of Science under Prof. Perry and the remaining two years at St. John's College, Cambridge, where he took his degree in 1914 on the research side, working under Prof. Bertram Hopkinson. In 1915 he joined the research staff of the engineering laboratory of the Royal Naval College, Greenwich, under Sir James Henderson, where he did good work on war problems for the Navy and Air services until 1918, when he was appointed principal of the Medway Technical Institute, Gillingham.

In this new post, Rowett left his mark as an organiser and teacher by re-equipping the laboratories and raising the standard to the requirements of the Board of Education, and when the new North Western Polytechnic was erected in London, he was selected to be its first principal. He planned the equipment, he gained the confidence of the Governors, the loyal co-operation of his staff and the affectionate regard of the students.

While at the Medway Institute, Rowett had taken the B.Sc. degree, London, in 1919, with first class

honours, and his D.Sc. degree in 1921 for a thesis on "Accurate Viscosity Determination of Fluids". His published papers deal with elastic hysteresis in steel, elastic properties of steel at moderately high temperatures, and viscosity of liquids; but his research work at the Royal Naval College has not been published.

Dr. Rowett was of a very retiring and modest nature, a skilful engineer and an ingenious research worker of great ability, very thorough in all he did. His work was his hobby, and forms a lasting memorial to him. Ill-health overtook him in his prime and he died at the early age of forty-six years. J. B. H.

WE regret to announce the following deaths:

Prof. A. V. Fomine, director of the Botanical Museum of the Ukrainian Academy of Sciences, and professor of botany in the University of Kiev, an authority on the Cryptogams and plant geography, on October 16, aged sixty-six years.

Prof. J. G. Goodman, emeritus professor of civil and mechanical engineering in the University of Leeds, on October 28, aged seventy-three years.

Prof. Frederick L. Ransome, professor of economic geology in the California Institute of Technology, on October 6, aged sixty-seven years.

News and Views

Sir Charles Sherrington, O.M., G.B.E., F.R.S.

THE official announcement of Sir Charles Sherrington's retirement from the Waynflete professorship of physiology at Oxford recalls the simple but moving ceremony which took place at the Oxford meeting of the Physiological Society in July. Sir Charles was then presented with an address recording his long association with the Society, and expressing the esteem and affection of his fellow members. These feelings are world-wide. Sir Charles's studies of the nervous system will command the admiration of neurologists for years to come, but those who have been privileged to know him personally have far more to admire. During his tenure of the chair at Oxford, the conception of the nervous system which he originated has become part of the classical doctrine of physiology. At the same time, his more recent studies have made Oxford the chief centre in Great Britain for research on the central nervous system. He has been president of the Royal Society, has served on countless scientific committees, and recently has done much for the improvement of scientific bibliography. Though we may regret the loss from active work of such a leader, we cannot grudge a rest and change of scene to one whose example has so enriched the scientific life of our time.

Progress in Medical Science

IN his Sir Halley Stewart Trust Lecture on October 31 in the Memorial Hall, Farringdon Street, London, E.C.4, Prof. Edward Mellanby, secretary of the Medical Research Council, discussed recent developments in medical science. He said that it is only in the past hundred years that medicine has made substantial advance. This relatively dormant state of knowledge lasting over a period of thousands of years was due partly to the idea that disease was caused by the invasion of the body by evil spirits—a view held by the Egyptians, Babylonians and Assyrians—and partly to the belief that man's body was of no account as compared with his soul—a view held throughout the Middle Ages. Landmarks of medical advancement were introduced on the anatomical side by the Italian school as represented by Vesalius and on the physiological side by Harvey, who gave the first classical demonstration of the possibilities of acquiring knowledge by the experimental method. By the time of Pasteur, the field was set for development and intensive study. Pasteur's work on enzyme action immediately opened up a new chapter of knowledge and led to the work of Lister on antiseptics and of Koch on bacterial disease in general. In the present century, medical research has become more and more intense. In Great Britain, the Medical Research Council was initiated in 1913 and, besides using its own public funds, it has the privilege of working in close association with the efforts of private benefactors such as the Lister Institute of Preventive Medicine, founded by Lord Iveagh, the Rockefeller Foundation, and the trusts formed by Sir Otto Beit and Sir Halley Stewart. On the administrative side, the greatly increased activities of the Ministry of Health and local health authorities have resulted in the application of new knowledge acquired by research to the practical problems of health.

PROF. MELLANBY gave some results showing the effect of advancement in medical science on mortality rates. The infant mortality rate in the period 1896–1900 was 156 per 1,000 births registered; in 1934 it was 59. The mortality rate of men between 45 and 55 years of age was 20·3 per 1,000 males in the period 1870 to 1875; in the period 1926–30 it was 11·7. Progress in medical science has tended in recent years to centre round three types of knowledge affecting: (1) Problems of infection—protozoal, bacterial and virus—and their control by raising the immunity. In this way such diseases as smallpox, measles, diphtheria, meningitis and scarlet fever have been influenced. In a group of 399 London children recently treated by immune serum, not one had died of measles, whereas in a control group the death rate

was 5 per cent. (2) Diseases due to abnormality of internal secretion, such as diabetes, pernicious anæmia, Addison's disease, myxœdema, cretinism and simple goitre, tetany and osteitis fibrosa cystica. As an example, reference was made to the latest results obtained in the treatment of pernicious anæmia by the pure or nearly pure anti-anæmic principle of liver as recently isolated by Dakin and West. So little as 0·2 gm. injected once weekly has a remarkable curative effect on this otherwise deadly disease. (3) Nutritional disease: Dr. Mellanby illustrated this subject by showing how discoveries leading to the cause, prevention and cure of rickets had been obtained. He also dealt with the problem of defective teeth and said that dental decay will remain a scourge in Great Britain unless methods are adopted of feeding infants and children on diets which would produce perfectly formed instead of the present imperfectly formed teeth. He described the beneficial effect of such substances as abundant milk, egg-yolk, fish and animal fats on dental structure, as compared with the harmful effect of cereals such as oatmeal, flour and other similar substances unless balanced by sufficient milk.

The Case Against Vaccination

In his Chadwick Public Lecture delivered at the Royal Society of Tropical Medicine and Hygiene, on November 1, Dr. C. Killick Millard discussed the vaccination question. In the past, one either had to believe in vaccination or to disbelieve in it. Dr. Millard said that his faith in vaccination, as a means for protecting the individual against smallpox, is just as strong and unassailable as ever it was, but he recognises that, as a State institution for protecting the community, infant vaccination has been largely a failure. Until recently, it was taught that the neglect of infant vaccination entailed serious and imminent risk of a return of smallpox mortality. The experience of the City of Leicester, which abandoned infant vaccination fifty years ago, and yet where, during the last thirty years, there have been only two deaths from smallpox, makes such a belief difficult. Since the War, an ultra-mild form of smallpox has appeared in Great Britain and considerable spread has taken place. It has now been officially recognised as a distinct variety, which breeds true, and it has been accorded a separate name, 'variola minor', to distinguish it from the severe form of smallpox, 'variola major'. As a matter of fact, although not officially recognised as such, variola minor existed in Great Britain long before the War, and in certain countries, under the name of 'alastrim', it has existed from time immemorial. Variola minor presents quite a different administrative problem from variola major. Compared with the latter it is non-fatal, non-disfiguring, non-loathsome. In some ways it is no more serious than vaccination, so that no case can be made out for retaining compulsory vaccination merely on account of variola minor. Dr. Millard concluded by expressing the opinion that the repeal of the vaccination Acts is now over-due.

Liberation of the Electron

For his Friday evening discourse at the Royal Institution on November 1, Mr. C. C. Paterson took as his subject "The Liberation of the Electron". He described how the whole art of electrical engineering had been born again when the electricity, which the older engineers had confined to wires and cables, was liberated from them by the physicist and handed back to the engineer to be exploited in the wireless valve, the photo-electric cell, the cathode ray tube, and other devices which use 'free electrons'. He demonstrated the essential causes which enabled these devices to establish broadcasting, long-distance telephony, television, and similar social services. The secret of the revolution is that a stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electricity can be increased or decreased at the rate of millions of times per second, or alternatively as slowly as desired, and no limit is set to the amount of energy which can be so controlled. So much of what we see and hear consists, if analysed, of extremely rapid happenings. The eye and the ear are unconscious of these high-speed fluctuations and vibrations, although sensitive to them. In order that we may faithfully reproduce and transmit these very rapid oscillations and variations, it is necessary to make exact electrical copies of them. This is done by suitably controlling a stream of free electrons. Mr. Paterson went on to point out how the free electron is also being used in astounding ways in the art of electric lighting. The many coloured luminous discharge tubes used for display purposes in the streets are due to the action of 'free electrons'. They have led the way to more brilliant and more efficient industrial light sources. Some of them give much more light for the electricity consumed than existing filament lamps. The effects are the result of high-speed (up to six million miles an hour) encounters between free electrons and the gas atoms in the tubes.

Science and Unemployment

In his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. M. Kennedy dealt mainly with the subject of the distribution of electricity. It is obvious that hand labour is gradually being replaced by mechanical power, and that a large fraction of the labour so displaced is unable to find further employment. There are certain depressed areas in which unemployment is particularly rife owing to the dying out of industries or their transfer to more suitable areas. It is now generally recognised that lack of forethought and absence of planning for the future during the recent rapid industrial development has been one of the main factors that has allowed these industrial troubles to develop. Absence of initiative and the policy of letting things drift often prevent real progress from being made. Mr. Kennedy discussed the relation between advancing applications of science and unemployment. He does not agree with those who fear that any steps taken to plan industry so as to re-absorb the present number of unemployed

will cause difficulty in the event of a great revival of trade. So far as the electrical industry is concerned, those employed in manufacturing, contracting and supply have grown in number from 200,000 to 330,000 in the last ten years. Scientific and technical development soon find a remedy for any potential shortage of work by increasing the rate at which power is developed and utilised. He reminded his hearers that electricity is a commodity in everyday use, and that it is unnecessary to fill up complex forms before it can be supplied. If the present rate of progress is to be maintained, more intensive effort and in many cases an appreciable reduction of tariffs is required.

School Dietaries

THROUGH the laxity of their parents in nutritional matters, nearly all children go to boarding schools as 'damaged goods'. This accusation, which is broadly true, is made by Prof. H. E. Armstrong in No. 7 of the gastronomical quarterly *Wine and Food*, in which he reviews Dr. Friend's book "The Schoolboy. A Study of his Nutrition, Physical Development and Health". Schools may not be able to repair the injury inflicted by parental carelessness, but at least they should not add to it, as they commonly do, by providing ill-planned dietaries during the crucial period of adolescence. For more than twenty years resident medical officer at Christ's Hospital, Dr. Friend has striven to better the physical condition of the boys passing under his care by improving the biological quality of the school diet. These experiments have been watched and encouraged by Prof. Armstrong in his capacity as a governor of the school. Prof. Armstrong is constantly directing his stinging wit and pungent criticisms at first one and then another public nuisance. The problem with which he is exercised at the moment is:

> "How should the little busy boy
> His belly daily fill?"

Prof. Armstrong urges the introduction of wholemeal bread; far more vegetables, particularly in a raw state; a comprehensive sausage including some of every kind of 'innards'; milk and milk products, of course. For the better provision of bone-forming minerals and vitamins, the milk should be from herds on lime-treated pastures, and in winter-time the cows should be fed on hay made from rapidly dried young grass.

THE large boarding school of the future will call for the exercise of special activities and of special intelligence on the part of the staff. The training of the child's character will be through that most wonderful House of Assembly, the 'tummy', and not through the pursuit of cricket and foot balls and dead languages. The school farm will be as carefully watched as the school classroom. Precious hours of sunlight will not be wasted indoors or the health-giving power of light be annulled by over-clothing. Dr. Friend initiated a great work, and Prof. Armstrong has been his staunch supporter, but how many boys' or girls' schools have such enthusiastic medical officers or governors? Though it is an improvement on customary school diets, the Christ's Hospital diet is still far from ideal: sugar is too plentiful; fresh fruit and vegetables too scarce; not all the bread is wholemeal, and more milk and potatoes might with advantage be included. The progress of experiments with improved diets is hampered in schools, and may be invalidated by the unintelligent opposition of the school teaching and domestic staff, and by lack of co-operation from the boys and girls, who resent food changes, and protest if their expenditure on the 'tuck shop' is curtailed. In spite of these obstacles, we hope the time is near when schools will ensure health not by fighting disease with an array of clinical thermometers and antiseptics, but, by means of proper food and sunlight, building sound bodies resistant to infection.

An Experiment in Political Education

THE 'educated electorate' dreamed of by the liberal statesmen of two generations ago is still to seek; the great mass of voters to-day are probably no better qualified than their ancestors of Gladstone's day to form independent judgments of the merits of rival candidates for election to Parliament. A similar deficiency stultifies democratic government on the other side of the Atlantic. The problem how to help the masses to achieve that critical thinking postulated by democratic theory was discussed in a stirring address delivered on July 26 at the University of Minnesota by Dr. J. W. Studebaker, United States Commissioner of Education. Attention was directed in the address to a remarkable experiment now in operation in Des Moines, Iowa, where the local education authority has inaugurated a public forum for adults. Its objectives are, (1) exchange of information and points of view, (2) development of tolerance and open-mindedness and (3) development of critical intelligence. It is recognised that the leader of such a forum must be a man of eminence in the academic world, with both the theoretical and practical knowledge of current affairs which would command respect and, above all, "that serene detachment which alone can guarantee clarity of judgment". The basic conception of the forum is educational with emphasis upon critical thinking as opposed to the emotional appeal and obscurantism of the demagogue. Such forums, Mr. Studebaker thinks, ought to be found in every city and village throughout America; and he forecasts support by the Federal Government for schemes for establishing them. University extension discussion classes in Great Britain were started with similar aims, but failed to attract as participants more than a minute proportion of the electorate. It will be interesting to see whether Mr. Studebaker's suggestions fructify.

Origins of Some Mechanical Inventions

FOR his presidential address to the Newcomen Society delivered on October 16, Mr. C. F. Dendy Marshall took the subject of "The Germs and

Development of Some Mechanical Inventions". His address, he said, followed a well-beaten track, but as many uncritical accounts and inaccurate illustrations have been published regarding the early history of pumps and engines, he thought it would be of interest to consider some of the earliest printed records. Recent research has shown that much less is known of such men as Ctesibius and Heron than our fathers thought they knew; and even in the case of Heron, the earliest manuscripts are posthumous to the extent of more than a thousand years. The first printed edition of his "Spiritalia" was in Latin and was published at Urbino in 1573. In this is described the first known application of heat to produce motion in fluids, a device for opening temple doors by the agency of heat, and the famous æolipyle. The word 'æolipyle' has been used by writers in three senses, namely, (1) for a vessel shaped like a retort for producing a jet of steam, (2) for Heron's engine and (3) for a wheel impelled by steam as invented by Branca. The word means the doorway of Æolus, that is, that of the cave in which the winds were kept. After touching upon some of the inventions described by Agricola, Porta, de Caus, Branca, D'Acres, von Guericke, Boyle and the Marquis of Worcester, Mr. Dendy Marshall made some interesting remarks on Papin and his invention of the safety valve. To the plug valve, Papin added the lever and moveable weight, but he did not propose it as a safety valve or hint that it might be useful to prevent explosions. From Papin, Mr. Dendy Marshall turned to the work of Savery and Newcomen on the steam engine, and concluded with some remarks on the early history of tramways, railroads and mechanically propelled vehicles.

Road Traffic in the United States

IN a recent radio talk given over the Columbia Broadcasting System, Prof. S. S. Steinberg, of Maryland University, discussed the highways of the United States. With more than 25 million motor vehicles, the business of highway transportation is one of the largest in the country. Last year, holiday motorists in the United States spent almost 600 million pounds. Highway facilities are still far from complete; only five per cent of the three million miles of rural roads are hard-surfaced, while only thirty per cent have received any kind of improvement. In many places, need for reconstruction is urgent, and the mileage of secondary light traffic roads required is very great. The loss of life due to accidents is high, as almost a hundred persons are killed every twenty-four hours, and last year one out of every hundred of the population was injured in a road accident, one of the gravest risks being the 'railroad grade' crossings, of which there are 240,000. About 1,500 persons are killed annually at these crossings; at least 30,000 such crossings are dangerous, and it will take many years before they can be made safe. Congress has provided sixty million pounds of emergency relief funds for this purpose, and the development of 'farm to market' roads will be a great boon to the country. The work will provide employment for many at present unemployed as the cost of constructing roads is mainly for labour. Mr. Robinson points out that the highways affect everyone vitally as they are the arteries which carry the life-blood of agriculture, commerce and industry, as well as bringing many social and educational amenities.

London and Home Counties Joint Electricity Authority

UNDER the Electricity Acts of 1919 and 1922, joint electricity authorities were set up, which were to be representative in these districts of the authorised undertakers, the local authorities, the county councils, the large consumers and other interests. In a pamphlet describing the opening of new electricity showrooms in Sutton, a list of those composing the Joint Electricity Authorities for London and the home counties is given, and a record of the progress that has been made since the Authority took over the undertaking. The list of the members is thoroughly representative, and wonderful progress has been made in developing the industry. By instituting two-part tariffs, assisted wiring and hire and hire-purchase schemes, the electric supply has been made available to the poorest people in the district served, which is mainly residential. The supply area covers 190 square miles and is divided into an inner and outer zone, consumers in the latter having to pay slightly more. The work was taken over in July 1932, and in July 1935 the number of consumers had increased by 89 per cent, the load having more than trebled. The Authority has done much useful work in standardising the apparatus and systems it has inherited. The whole of Surbiton has been changed from direct current to alternating current, and in Sutton the supply is being converted from 200 volts to the standard 230 volts. Practically the whole of the supply is being received in bulk from the Central Electricity Board. The bulk supply from the Grid is taken at 33 kilovolts, transformed at the Grid substations to 11 kilovolts and then transmitted to the Authority.

Climate and Health

AT the Harrogate Congress of the Royal Institute of Public Health, Mr. L. C. W. Bonacina delivered an address on "The Study of Weather and Climate in Relation to Public Welfare", which has been published in the *Journal of State Medicine* (43, No. 10). He points out that the effect of climate on general well-being is so complex that it is not possible to discriminate between the different elements, but that in Great Britain the general effect is distinctly favourable. Hence it follows that the effect of a marked change of climate, even if superficially an improvement, as for example a doubling of the amount of bright sunshine, might not really be to our advantage. The great importance laid on sunshine is "probably only an exaggerated response to the evil consequence of smoke-vitiated light and air in the great industrial centres, and the curative results in proper doses of natural or artificial sunlight". The wind and the rain, by cleansing the air, are also of great value,

and Mr. Bonacina is in full agreement with the trend of modern ideas in emphasising the importance for health of frequent contrasts of weather, and especially of temperature and wind. He ends on a practical note by insisting that the open-air study of weather and especially clouds also makes for health by training the powers of observation and inference. Forecasts 'on tap' by wireless are a very good thing, but there are occasions, for example in mountaineering, when much discomfort or even risk might be avoided by the ability to foresee a storm an hour or two ahead.

Meteorology of Southern Rhodesia

THE annual report of the Meteorological Department of the Department of Agriculture of Southern Rhodesia for the year ended June 30, 1934, follows the general lines of previous reports (Salisbury: Department of Agriculture, 1934). In the rainy season of 1933–34, as in that of the preceding season, there was substantially less rain than usual, although the formula used for predicting the season's fall had indicated an excess of rain. During the five years for which this computation has been made, this was the first occasion on which the sign of the departure from the normal was not correctly given by the formula. An Aircraft Weather Service that had been organised for Imperial Airways operated satisfactorily during this year, and it was decided to extend the service to all aircraft. Arrangements were made to transfer the observatories at Salisbury and Bulawayo to the aerodromes, where they will be maintained by a staff of two, who will prepare regular weather reports and forecasts, and make observations of the upper winds. According to the report, the provision of an adequate weather service for aircraft is now regarded as the most important function of the Meteorological Department. The number of tables in the report has been reduced owing to financial stringency; but among those included is an interesting one showing the average Rhodesian rainfall for thirty-six years. In the first season, 1898–99, the fall was based on the records of seven rain-gauges, and in the most recent (1933–34), on three hundred and forty-four.

A Totalising Anemometer

IN the *Hydrographic Review*, 12, No. 1, Dr. J. N. Carruthers describes a suggested totalising anemometer for oceanographers, the records of which he considers likely to be of value in climatology. Although the ordinary Robinson anemometer is a totalising instrument in so far as it registers the number of miles and fractions of a mile of air that have flowed past the anemometer in a given time, it does not distinguish between the different wind directions, and its records can only be used for obtaining the total run in particular directions in the case of the more complicated self-registering form of this instrument that records automatically both the run and the direction, and then only after laborious calculations. In the instrument described by Dr. Carruthers, a wind vane is used which rotates a vertical rod bearing at its lower end a circular tank divided radially into eight equal compartments, each of which has a draw-off tap. A separate mast carries a 4-cup anemometer which makes and breaks an electric circuit after a certain run of wind past the cups. When the circuit is made, it energises a solenoid and the latter rocks a small pipe which is pivoted on the rim of a tank in which water is maintained at a constant level by means of an ordinary ball valve. This pipe carries a dipper which delivers a definite quantity of water through it into whichever of the eight compartments of the circular tank is beneath at the time. At the end of a period of observation, the total run of air in each of the eight directions is readily obtained by drawing off and measuring the quantity of water in each compartment.

Co-ordination of Scientific Surveys

AT the recent meeting at Norwich of the British Association, Mr. E. Wyllie Fenton made an interesting plea, in a paper read before Section K (Botany), for the extension and co-ordination of the existing Ordnance and Geological Surveys into a wide body to carry out periodic surveys not only of topography, rocks and soils but also of vegetation, agriculture and animal life. Mr. Wyllie Fenton's illustrations of the wider need were mainly botanical, as for example, the invasion of valuable land in Scotland by bracken moving downhill to the better land "like a series of plant glaciers", and the association of this fact with changes in land settlement and agricultural practice. A plea was advanced for a prompter recognition of these significant changes in vegetation and in the results of changes in population, distribution, etc., with the argument that a more scientific utilisation of the land, in housing development, in agriculture and in forestry, etc., would be possible if such a general scientific survey service provided the data. Mr. Fenton recognises, however, the ambitious nature of such a proposal, and suggests that a start might be made by the attachment of a few botanists to the Geological Survey.

Metals in the Chemical Industry

IN his Jubilee Memorial Lecture of the Society of Chemical Industry delivered before the Yorkshire Section at Leeds on November 6, Dr. C. H. Desch took as his subject "Metals in the Chemical Industry". The range of both ferrous and non-ferrous metals available for the purposes of chemical industry has been immensely widened in recent years. Resistance to chemical attack is one of the first considerations, and as no one material is resistant to all chemical agents, a choice must be made in each instance, for which ample data now exist. Corrosion fatigue, caused by the simultaneous action of fluctuating stress and of a chemical agent, is quite different from the sum of the actions of fatigue and corrosion, and is responsible for many unexpected failures. Special conditions arise where high temperatures and pressures are involved. Resistance to 'creep' is required as well as chemical resistance, and internal changes may cause progressive weakening. Not only chemical

composition, but also texture, determine the degree of resistance to all these factors. The qualities of metals required for chemical purposes may be improved by (*a*) the elimination of impurities, (*b*) adding other metals in such quantities as to produce substantially new alloys, or (*c*) adding very small quantities of foreign elements which produce an effect great in proportion to their amount.

Neolithic Camp in Sussex

DISCOVERIES which will have a bearing of no little importance on the future study of the neolithic age in Britain are reported from Whitehawk Camp, near Brighton. Mr. E. Cecil Curwen, acting on behalf of the Sussex Archæological Society, with the assistance of Miss Leslie Scott, who has worked at Maiden Castle, Dorchester, has held an archæological watching brief while the Corporation of Brighton has been engaged in constructing a road across the camp. Whitehawk Camp, which is scheduled under the Ancient Monuments Acts, is one of the largest and best surviving specimens of the neolithic camp of concentric interrupted ditches. In places, the original ramparts still stand seven feet high. The line of the road cuts the line of all four ditches on both sides of the camp, and these are now being cleared down to the bottom and the original chalk. According to a report in *The Times* of November 4, up to the present, the inner ditch has proved rich in neolithic pottery, also yielding great quantities of animal bones, flint flakes, saws, scrapers and a flint axe. Two small pits full of neolithic pottery and animal bones appear to be unconnected with the ditches. Another interesting discovery is a piece of chalk scored with a chess board pattern, similar to a device found on the wall of a pit shaft on Harrow Hill, near Cissbury. Several post-holes on the ramparts appear to have supported palisades, and a similar structure is indicated as forming a side wall to the entrance passage through the outer rampart. These are unique in British neolithic camps. The pottery, which is of modified Windmill Hill type and a type with whipped cord impressions, suggesting Peterborough ware (Neolithic *B*), should prove an important addition to existing material.

Etruscan Forgery in the British Museum

MEMORIES of an ancient controversy are revived by the action of the Trustees of the British Museum in withdrawing from exhibition in the Department of Greek and Roman Antiquities at Bloomsbury the widely known "Cervetri Sarcophagus". The revived and extended interest in Etruscan antiquity, marked especially by the recent publication of Dr. D. Randall-MacIver's researches in the history and affinities of Etruscan culture, is, no doubt, largely responsible for the removal of a piece of which the antiquity and authenticity can no longer be held to be a matter of question, in view of the more critical examination to which details of design, structure and style can now be submitted in the light of greatly extended knowledge. Doubt as to the genuine character of the sarcophagus, indeed, was raised very soon after its acquisition by the British Museum as part of the Castellani collection in 1873; and it was pointed out in March of the following year that the inscription on its lid was derived in part from a gold brooch in the Louvre, while another inscription, which had been misread, was indicated later as another possible source. The spurious character of the inscription has been admitted even by some who were prepared to argue for the sarcophagus as a genuine ancient example of Etruscan art. Now, however, the recognition of anachronistic and incongruous details in form and design stamp it as a forgery beyond dispute. There can be little doubt that the story to which reference is made in *The Times* of November 2 embodies the truth which came out in the quarrel between the brothers Pennelli, of whom Enrico, employed at the Louvre, boasted that he had made the sarcophagus, while Pietro had sold it to Castellani, stating that he had excavated it at Cervetri. It is unfortunate that the inquiry demanded by Sir Charles Newton, keeper of the Department at the time, was not pressed home.

The Realm of the Stars

The Realm of the Stars, or *Říše Hvězd*, is the title of a monthly journal edited by Dr. Hubert Slouka and published by the Czechoslovak Astronomical Society, which now has more than a thousand members. One of the objects of the Society and its journal is to encourage a wider appreciation of astronomy among educated Slav peoples, and from the journal it is evident that Czechoslovak astronomers are familiar with modern progress and with the latest instruments in use elsewhere. In the last few issues of the journal there are recent photographs showing the appearance of the moon's surface, some spectrographs taken in Czech observatories and a number of illustrated semi-popular contributions and reports. One issue is mainly devoted to the proceedings of the international astronomical meeting held in Paris during July. Czechoslovak astronomers have interested themselves in such subjects as sunspots, the atmospheres of planets, and celestial bombardment. In the annual report for last year it is stated that 11,797 people and 130 school groups visited the Štefánik Observatory, near Prague. The Society also has observatories and branches in several provincial centres, and noteworthy observations from these groups are reported in *Říše Hvězd*, but being in the Czech language they can appeal only to their own members and, in a limited degree, to colleagues in other Slav countries.

Nature Protection in Poland

A CENSUS of the wild creatures in the famous Polish National Park of Bialowicza gives the present numbers as 4 wolves, 9 lynx, 3 otters, 5 martens, 4 foxes, 5 badgers, 82 wild boars, 29 stags, 72 roebucks and many hares (*Quarterly Information Bulletin concerning the Protection of Nature in Poland*, 5, II; 1935). In the Park, there now exist 17 European bison, including half-bred individuals, and in Poland as a whole there are 21 of pure breed, out of the 70 known to exist in the world. The State Council for the Protection of Nature in Poland has issued three

small albums, each containing 12 picture postcards of the natural features and the animal and plant life of the parks and reservations, which should help to spread the knowledge of these magnificent natural areas. It is curious to look upon these activities in Poland and the interest of the State and people in them, and to consider that in our more highly populated land, where the need for protection is greater than in Poland, there is no national park at all, and no State attempt to protect the disappearing land mammals, which were once as varied in kind as those of Poland now are.

Campaign against Noise in New York

THE New York campaign against noise officially started on October 1, when the Mayor instructed the police to warn offenders and to educate the public without making arrests. The sounding of motor horns between 11 p.m. and 7 a.m. is prohibited, and citizens have been instructed to keep their wireless apparatus at a moderate level. During the first three days, 4,071 warnings were given and 9 summonses were issued. The League for Less Noise has established an office for investigation of complaints, among which motor horns and barking dogs are most frequently mentioned.

Early Frost in 1835 and 1935

THE note entitled "The Horticultural Society" which appeared in NATURE of October 19, p. 654, refers to the occurrence of a severe frost (27° F.) on October 20, 1835. Miss E. Armitage, writing from Dadnor, Ross, Herefordshire, remarks that the first frost this season took place on October 20, 1935, with 6° F. of frost. All tender autumn flowers were killed, and, in particular, some spikes of *Kniphofia maxima globosa*.

Canadian Earthquake of November 1

FROM the brief account of it that has so far been received, the earthquake that disturbed eastern Canada and New England shortly after 1 a.m. on November 1 seems to be one of great interest. The epicentre is placed by Canadian seismologists at a point about 250 miles north of Ottawa. The shock was severe throughout the whole northern Abitibi region, and at one place railway lines were torn up and twisted. The earthquake is remarkable, however, not so much for its intensity in the central district, which does not seem to have been unusual, as for its large disturbed area. To the south, it was felt at Chicago, Washington, New York and Boston. The northern limit of the disturbed area may be difficult to trace, as it traverses a sparsely inhabited country, but the total area probably exceeds three-quarters of a million square miles, an amount not often surpassed in North American earthquakes.

Announcements

THE Mackinnon research studentship of the Royal Society has been awarded to Dr. G. W. Brindley, assistant lecturer in physics in the University of Leeds, for his research on X-ray reflections from metals in relation to atomic vibrations.

MR. P. L. O. GUY has been appointed Director of the British School of Archaeology in Jerusalem for the year ending September 30, 1936, on the retirement of Mr. J. W. Crowfoot. Mr. Guy was formerly chief inspector of antiquities for the Government of Palestine, and has had many years experience of field work and excavation. He has already taken up residence in Jerusalem.

DR. S. I. LEVY will deliver the Brauner Memorial Lecture of the Chemical Society on November 14, at 8, in the rooms of the Society at Burlington House, Piccadilly, London, W.1.

A DISCUSSION on "Some Aspects of the Interaction between Gases and Solids" will be held at the Chemical Society on November 21 at 8 p.m. The discussion will be opened by Prof. E. K. Rideal, who will be followed by contributions from Dr. J. K. Roberts and Dr. R. M. Barrer.

A COMMITTEE has been formed under the presidency of J. A. van Heuven in connexion with the celebration of the three hundredth anniversary of the foundation of the University of Utrecht in 1636.

ERRATUM.—In the last line of the letter by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew entitled "Emission of Positrons from a Thorium-Active Deposit" published in NATURE of September 21 (p. 475), the words "per cent" should have been inserted after "0·02–0·03".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in chemistry in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3—The Principal (Nov. 20).

A civilian technical officer in the Admiralty Technical Pool (engineering or physics)—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Nov. 22).

A principal of the Municipal College, Southend-on-Sea—The Director of Education (Nov. 25).

A deputy director of agriculture in East Sussex, who will also act as vice-principal of the School of Agriculture, Plumpton—The Director of Agriculture, County Hall, Lewes (Nov. 25).

A lecturer and research assistant in the Department of Higher Degrees and Research in the Institute of Education, Southampton Row, W.C.1—The Secretary (Nov. 25).

A head of the Physiology Department of the Rowett Research Institute, Bucksburn, Aberdeenshire—The Secretary (Nov. 30).

A director of the Laboratory of Bacteriology and Pathology in Adelaide Hospital, who will also act as Director of Medical Research in the University of Adelaide—The Agent General for South Australia, British Industries House, Marble Arch, London, W.1 (Dec. 12).

A University professor of statistics in the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 31).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 761.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

Radioactive Indicators in the Study of Phosphorus Metabolism in Rats

RECENT progress in the production of radioactive isotopes by neutron bombardment makes the radioactive isotope of phosphorus $_{15}P^{32}$ easily accessible. This isotope, which has a half-life value of 17 days, can be utilised as an indicator of inactive phosphorus in the same way that the radioactive isotopes of lead, bismuth and so on were formerly used as indicators of these elements. If, for example, we add active $_{15}P^{32}$ to 1 mgm. of inactive phosphorus in such quantity that the Geiger counter registers 1,000 impulses per minute, carry out with the phosphorus activated in this way any sort of chemical or biological reaction and then find that the product obtained gives 1 impulse per minute, we may conclude that 1/1,000 mgm. of the phosphorus originally introduced is present in the product investigated.

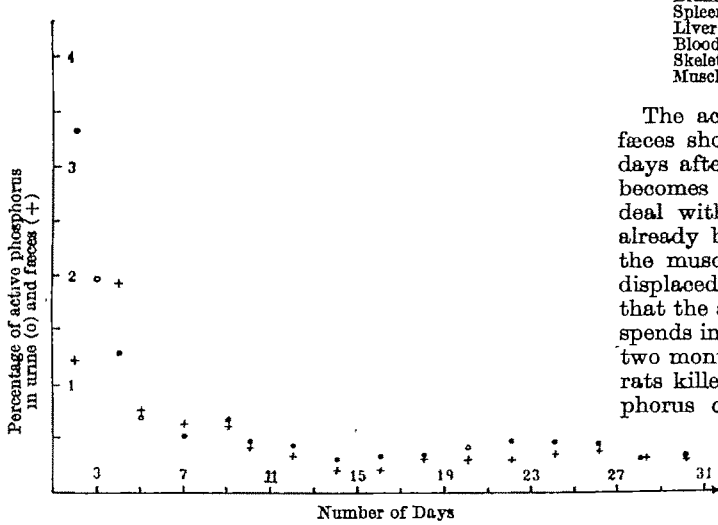

FIG. 1.

(On the first day, 7 4 per cent of phosphorus was found in the fæces and 5 per cent in the urine)

Rats were fed with a few milligrams of sodium phosphate containing $_{15}P^{32}$ as indicator. The radioactive phosphorus present in the urine and fæces was then investigated for a period of a month. The result is shown in Fig. 1, which shows the percentage of the 2 mgm. of phosphorus taken, found daily in the excrements. The rat was killed, and, after ignition, the phosphorus content of the different organs was investigated. The result of an experiment in which the rat was killed 22 days after being fed on active phosphorus is seen in the first column in Table 1. The largest part of the phosphorus taken is present in the bones, and the smallest in the kidneys. When, however, we take into account the very different weights of the different organs and calculate the phosphorus content of the latter per gram after drying, we obtain a very different picture, as seen from the second column in Table 1. The spleen, kidneys, and the brain are found to contain per gram most of the active phosphorus. During one of the experiments, the rat produced six offspring on the seventh day, of which five were eaten by the mother; this caused a large increase in the active phosphorus content of the excreta in the following three days. The presence of 2 per cent of the 2 mgm. active phosphorus taken by the mother was revealed by the analysis of the remaining offspring.

TABLE 1.

Distribution of the active phosphorus in the rat

	Per cent	Per cent per gm.
Urine	26·3	
Fæces	31 8	
Brain and Medulla	0·5	14 7
Spleen and Kidneys	0·2	18 2
Liver	1·7	13 9
Blood	0 4	1·8
Skeleton	24 8	2·8
Muscles and fat	17·4	7·4

The active phosphorus content of the urine and fæces shows great fluctuations during the first few days after the intake of the preparation. Later, it becomes fairly constant; and we have obviously to deal with the excretion of phosphorus which has already been deposited for a while in the skeleton, the muscles, or other organs, and which has been displaced again. From our experiments, it follows that the average time which a phosphorus atom thus spends in the organism of a normally fed rat is about two months. This is also supported by the fact that rats killed about a month after the intake of phosphorus contain only about half the active phosphorus found in those killed after a week's time. This result strongly supports the view that the formation of the bones is a dynamic process, the bone continuously taking up phosphorus atoms which are partly or wholly lost again, and are replaced by other phosphorus atoms. In the case of an adult rat, about 30 per cent of the phosphorus atoms deposited in the skeleton were removed in the course of twenty days.

In another set of experiments we investigated the different parts of the skeleton. No conspicuous differences in the active phosphorus content could be found, with the exception of the teeth. The front teeth, which grow rapidly in rats, contained a larger part of the 2 mgm. phosphorus taken than the average of the whole skeleton, the ratio being about 10 : 1 in the case of adult and 6 : 1 in that of half-adult rats, whereas the molar teeth took up less than the average per gram of the skeleton, the ratio being 1 : 2 in the most extreme case. A detailed account of these and further results will be published elsewhere.

We wish to express our thanks to Prof. Niels Bohr for the kind interest he has taken in this work. For the preparation of the radioactive sources, and helpful assistance in making the measurements, we would also like to thank Mr. J. Ambrosen and Mr. S. Høffer-Jensen.

O. CHIEWITZ.
G. HEVESY.
Finsen Hospital and
Institute of Theoretical Physics,
Copenhagen.
Sept. 13.

Induced Radioactivity by Bombarding Magnesium with α-Particles

THE publication of the full details of the following experiments will be somewhat delayed owing to the departure of one of us to Canada. We wish, therefore, to state briefly our main results.

We have examined in detail the induced radioactivity produced by bombarding magnesium with α-particles. The main effect is due to the well-known body Al^{28}, which emits β-rays and has a period of 137 sec.

$$_{12}Mg^{25} + {}_2He^4 \rightarrow {}_{13}Al^{28} + {}_1H^1$$
$$_{13}Al^{28} \rightarrow {}_{14}Si^{28} + \varepsilon^-.$$

In agreement, however, with Curie and Joliot[1], and with Eckardt[2], we have found the induced radioactivity to be complex, and by analysing the emission with a magnetic field, we have been able to identify two other bodies, present in only small quantities, one emitting β-rays with a period of about 11 minutes, and the other emitting positrons with a period of 5–7 minutes. We suggest these bodies are respectively Al^{29} and Si^{27}, formed as follows:

$$_{12}Mg^{26} + {}_2He^4 \rightarrow {}_{13}Al^{29} + {}_1H^1$$
$$_{13}Al^{29} \rightarrow {}_{14}Si^{29} + \varepsilon^-$$
$$_{12}Mg^{24} + {}_2He^4 \rightarrow {}_{14}Si^{27} + {}_0n^1$$
$$_{14}Si^{27} \rightarrow {}_{13}Al^{27} + \varepsilon^+.$$

By investigating the relative yield of these three bodies when produced by α-particles of different energies, we are led to believe that Mg^{25} has a strong resonance level for α-particles of energy less than $5{\cdot}4 \times 10^6$ volts, and that either Mg^{24} or Mg^{26}, or both, have a resonance level for α-particles of energy between $5{\cdot}4$ and $6{\cdot}1 \times 10^6$ volts.

Using α-particles of energies up to $6{\cdot}6 \times 10^6$ volts to bombard a thick layer of magnesium, we find that the cross-section (integrated over all energies) for proton emission from Mg^{25} is about thirty times that for proton emission from Mg^{26}, and about three hundred times the cross-section for neutron emission from Mg^{24}.

While Al^{29} has a period of 11 minutes and Al^{28} only 2·3 minutes, yet we find that the β-rays from Al^{29} are more penetrating than those from Al^{28}. This suggests that Al^{28} undergoes a 'permitted' transition (no change of spin) while for Al^{29} the transition is 'non-permitted' (change of spin). The strong γ-ray emission from Al^{28} shows that the Si^{28} nucleus is usually formed in an excited state, whereas our experiments suggest that Si^{29} is usually formed in the ground state.

The discussion of these results will be deferred until the publication of the full details of the experiments.

C. D. ELLIS.
W. J. HENDERSON.
Cavendish Laboratory,
Cambridge. Oct. 29.

[1] Curie and Joliot, *J. Phys.*, 5, 153; 1931.
[2] Eckardt, *Naturwiss.*, 30, 527; 1935.

$_{19}K^{42}$ and the Radioactivity of Potassium

IT has recently been suggested by Newman and Walke[1] and Klemperer[2] that the natural β-radioactivity of potassium is due to an isotope $_{19}K^{40}$ present in very small abundance. Sitte[3], however, has come to the conclusion that another relatively rare isotope of potassium exists which is the source of the β-particles, and this, he states, can only be $_{19}K^{43}$.

It is to be noted in this connexion that β-ray emission occurs from isotopes in which too many neutrons are present, so that we should anticipate, in general, that when two or more β-radioactive isotopes of a single element exist, that those with the higher number of neutrons would have the shorter lives. This is clearly indicated by the unstable isotopes of thallium:

$_{81}Tl^{210}$ (RaC″)	1·32 min.
$_{81}Tl^{208}$ (ThC″)	3·20 min.
$_{81}Tl^{207}$ (AcC″)	4·76 min.

Hence it appears probable that $_{19}K^{42}$ would have a shorter period than $_{19}K^{43}$, since it has a higher number of nuclear neutrons. As the period of $_{19}K^{43}$ is 16 hours, it is apparent that $_{19}K^{42}$ could not be the source of the natural radioactivity of potassium.

The period of this isotope could probably be tested by preparing it artificially. Rutherford and Chadwick have observed the emission of protons from argon when bombarded with α-particles. Since $_{18}A^{40}$ is 160 times as abundant as $_{18}A^{36}$, it is almost certain that the protons are produced by the reaction:

$$_{18}A^{40} + {}_2He^4 \rightarrow {}_{19}K^{43} + {}_1H^1.$$

Thus by bombarding argon with strong sources of α-particles it should be possible to detect the β-radioactivity of $_{19}K^{42}$.

Finally, it is to be noted that Nier[4], using a special type of mass-spectrograph, has detected $_{19}K^{40}$ present in normal potassium to the extent of about one part in 8,600, whereas he found no trace of either $_{19}K^{42}$ or $_{19}K^{43}$ and concluded that these isotopes, if they exist at all, were present in abundance less than one part in 150,000.

It is apparent, therefore, that the hypothesis of Newman and Walke[1] and Klemperer[2] is confirmed by mass-spectrographic evidence, whereas that of Sitte[3] is not.

Note added in proof. The existence of $_{19}K^{40}$ has been confirmed by Brewer (*Phys. Rev.*, 48, 640; 1935), who estimates the ratio K^{39}/K^{40} as 8,300 ± 100.

H. J. WALKE.
Radiation Laboratory,
University of California,
Berkeley.
Sept. 12.

[1] Newman and Walke, NATURE, 135, 98; Jan. 19, 1935. *Phil. Mag.*, 19, 767: 1935.
[2] Klemperer, *Proc. Roy. Soc.*, A, 145, 638; 1935.
[3] Sitte, NATURE, 136, 334, Aug. 31, 1935.
[4] Nier, *Phys. Rev.*, 48, 283; 1935.

A Molecular Map of Resorcinol

ALL those organic compounds which have until now yielded to quantitative X-ray analysis display some element of molecular symmetry in the crystal. The structure of the complete chemical molecule can then be built up from a fraction by symmetry operations, thus greatly simplifying the analysis. But some of the most interesting structures have a lower symmetry, and in these cases the molecule must be treated as a whole. This applies to resorcinol, space

group C_{2v}^{9} (P_{na}), $a=10\cdot53$, $b=9\cdot53$, $c=5\cdot66$ A., where the asymmetric unit consists of one chemical molecule. A quantitative analysis of this compound has now been carried out, and the preliminary results have been refined by a double Fourier synthesis which is shown in Fig. 1.

Although the benzene ring is inclined at a high angle to the plane of this projection, it can be seen to answer the tests of a regular plane hexagon. Now if we assume the usual C-C interatomic distance of 1·41 A., the complete orientation of the molecule in the crystal can be calculated from this diagram. The centres of the OH groups are then found to be situated at 1·35 A. from the benzene nucleus. The line joining the OH groups, lying in the plane of the ring, makes angles of 134°, 46° and 101° with the *a*, *b* and *c* crystal axes, and the line perpendicular to this, also in the plane of the ring, lies at 63°, 77° and 149° to these axes.

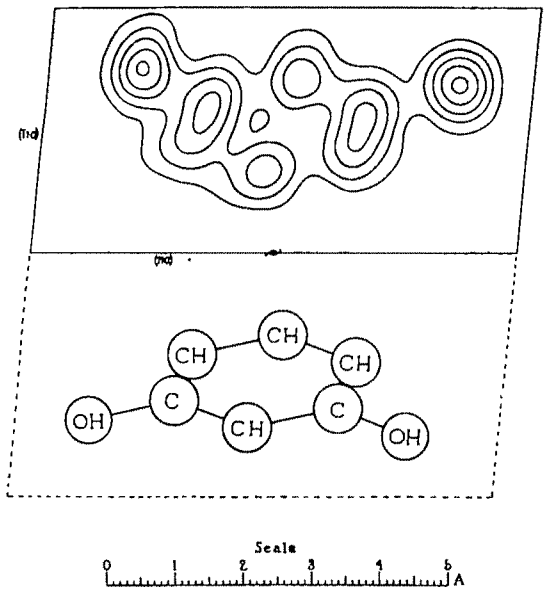

FIG. 1. Resorcinol. *c* axis projection. Each contour line represents a density increment of two electrons per square A.

Perhaps the most interesting aspect of the structure is the close approach of the hydroxyl groups on adjoining molecules (not shown in Fig. 1). These groups are arranged in spiral formation about the dyad screw axes, and the distances between successive groups belonging to neighbouring molecules are 2·66 A. and 2·76 A. Now these distances are much less than the observed approach distances for molecules of hydrocarbons (3·4–3·8 A.), where only residual or van der Waals' forces are acting. In benzoquinone, the minimum distance between oxygen atoms on neighbouring molecules is 3·62 A. It is evident that some type of secondary valence force must be assumed between the hydroxyl groups of adjacent resorcinol molecules. From the order of the distances this would appear to be either a strong 'hydroxyl bond', or something intermediate between the Huggins and Pauling hydrogen bond and the hydroxyl bond recently discussed by Bernal and Megaw[1].

J. MONTEATH ROBERTSON.

Royal Institution,
London, W.1.
Oct. 12.

[1] *Proc. Roy. Soc.*, A, 151, 384; 1935.

Lecithin as a Dispersing Agent for Dibenzanthracene

DURING the course of experimental work in connexion with his study of cancer at this Institute, Dr. M. J. A. des Ligneris expressed a desire to study the effect of dibenzanthracene on tissue cultures *in vitro*, and invited the co-operation of the Biochemical Department in devising a suitable means of introducing this substance into tissue culture media.

Since dibenzanthracene is insoluble in aqueous media, the preparation of a colloidal solution was considered. Orthodox methods of dispersion from alcoholic solution were unsatisfactory because the low solubility of dibenzanthracene in even boiling alcohol necessitated the addition of so much of the alcoholic solution that toxic concentrations of alcohol were attained. Moreover, in physiological salines no dispersion occurred unless protective colloids such as serum proteins were present.

Familiarity with the properties of lecithin suggested the possibility of using it as a protecting agent. As a preliminary experiment, 100 mgm. lecithin (crude acetone-insoluble lipoid from egg-yolk) and 50 mgm. dibenzanthracene were ground together in an agate mortar for half an hour, moistening occasionally with distilled water. By means of 50 ml. of Ringer's solution the mixture was then transferred to a bottle and shaken for two hours. The resultant fluid was yellower than a solution of 100 mgm. of lecithin alone in 50 ml. of Ringer and remained so on standing a few days despite the settlement of a yellow deposit.

Although aseptic precautions had not been observed, the fluid proved to be sterile on bacteriological control, and was passed on to Dr. des Ligneris for use. His results will be published shortly.

A similar result has since been obtained by dissolving lecithin in a 0·5 per cent solution of dibenzanthracene in benzene, removing the solvent by causing a jet of air to play on the surface and taking up the mixture in Ringer's solution.

No attempts have been made to determine optimum proportions of lecithin and dibenzanthracene, since the above solution appeared to be sufficiently stable for the purpose intended and the examination of colloidal solutions is not regularly undertaken in this laboratory.

H. D. BARNES.

South African Institute
for Medical Research,
Johannesburg.
Sept. 23.

Chemical Nature of the Amino Acids excreted by Leguminous Root Nodules

SOME years ago we showed conclusive evidence that considerable amounts of nitrogenous compounds appear in the medium in inoculated, but otherwise sterile, cultures of leguminous plants. Since then we have tried to isolate these nitrogenous compounds and to determine their chemical nature. The nitrogen compounds were extracted from the quartz sand with water and found to consist chiefly of amino acids. Amino nitrogen determinations according to van Slyke—the reaction mixture being shaken for 30 minutes—showed that 87–98 per cent of the total nitrogen was amino nitrogen. The amino nitrogen values varied to some extent in different extracts.

Further analysis of the amino acid mixture has now led to the following results. About 50 per cent of the total nitrogen consists of amino nitrogen of aspartic acid. This amino acid has been estimated

quantitatively by the aspartase enzyme, and identified qualitatively in the form of the copper salt. Approximately the other half of the nitrogen (40–50 per cent) is precipitable by phosphotungstic acid. Since cystine, arginine, histidine and aromatic amino acids are absent, it is probable that this fraction consists of lycine. Further work is in progress to determine the nature of the compounds precipitated by phosphotungstic acid.

In an earlier paper[1], it was mentioned that aspartic acid is not present in the amino acid mixture. This erroneous conclusion is ascribable to the fact that, owing to the small amount of material available, the determination was made from the solution from which ammonia had first been distilled off according to van Slyke, in which process aspartic acid seems to be precipitated as a calcium salt.

The composition of the excreted amino acid mixture is very interesting in several respects. In the first place, it confirms our earlier view that the excretion is not ascribable to decomposition of the nodules or the roots. According to our recent investigations the nodule protein contains a variety of different amino acids (tryptophane, tyrosine, arginine, etc.). Hence it follows that, should the excretion be due to decomposition of this protein, the amino acid mixture in the medium would also contain several different amino acids. In view of the fact that the rate of excretion is highest at an early stage of growth, it seems very likely that the excreted compounds represent the primary amino acids formed in the fixation of nitrogen. Since aspartic acid is formed from fumaric acid through a well-known enzymatic reaction, the excretion of large amounts of aspartic acid is a most interesting phenomenon. On the other hand, it is also interesting to note that, in sterile cultures, aspartic acid forms an excellent source of nitrogen for uninoculated leguminous plants, as we have earlier found.

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T. LAINE.
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for Chemical Research,
Helsingfors.
Oct. 8.

[1] Virtanen, v. Hausen and Karström, *Biochem. Z.*, 258, 106; 1933.

Quantitative Determination of Ascorbic Acid

AT the sixth Caucasus Congress of Physiologists, Pharmacologists and Biochemists, held in Erivan, Armenian S.S.R., on October 11–17, 1934, a communication was made by A. G. Jonnissian under the title of "Uber den Chemismus des Vitamin 'C' ".[1]

Amongst other conclusions of the author occurs the statement "Fruktose und Arabinose geben mit dem Reagens nach Tillman [*sic*] ein positives Resultat".

Tillmans recommended the use of 2 : 6 dichlorophenolindophenol, which has been found by many workers to be a quantitative reagent for ascorbic acid. It is known not to be strictly specific, but the number of naturally occurring substances that have so far been found to interfere with the determination of ascorbic acid by this dyestuff is not great, and methods have been evolved for eliminating their interference. If it were true that widely occurring sugars also interfered, the value of the reagent would be severely limited, and doubt might be cast on much published work.

Using the ordinary technique, we have examined specimens of purified *l*-fructose and *l*-arabinose, and in neither event have we been able to detect the slightest reducing action on Tillmans's reagent. We have no explanation to offer of Jonnissian's results, but we thought it might be of interest to publish the above facts, in case that author's statements should lead other workers to under-value what has come to be recognised as an extremely useful reagent.

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Oct. 18.

[1] *Proc. 6th Cauc. Cong. Phys. Pharm. Bio.*, Academy of Sciences Press, Moscow and Leningrad, 101; 1935.

Colloid Osmotic Pressure of the Body Fluids of Marine Animals

EXCHANGES of water between blood and tissues are generally believed, since Starling's work, to be regulated by the equilibrium of two forces, namely, hydrostatic capillary pressure which drives water out into the tissues, and blood colloid osmotic pressure which draws it into the vessels. Based on clinical and experimental investigations, I pointed out several years ago that this assumption leaves out of consideration the role of the tissues, which are, from a physico-chemical point of view, a much more complicated system than blood. In my opinion, the hydration of tissues determines the colloid osmotic pressure of blood, this pressure being but an intermediary between the different tissues[1].

Comparative physiology has furnished a strong argument in favour of this view. According to Krogh[2], "when the body is immersed in water the hydrostatic pressure is everywhere counterbalanced and all the capillary systems can be considered as being at the level of the heart. This is probably of some importance for large aquatic animals such as whales which should therefore, in spite of their enormous size, require only a low colloid osmotic pressure in the blood to prevent filtration". This presumption should, *a fortiori*, be valid also for animals of smaller size. I have therefore measured the colloid osmotic pressure of the body fluids of marine animals (serum of fishes, hæmolymph of Crustaceans, Molluscs and Tunicates, cœlomic fluid of *Sipunculus*). The following average values have been given by 140 measurements:

	Colloid osmotic pressure (cm.H_2O)	
Sipunculus nudus	0·95	(0·7–1·2)
Lamellibranch Molluscs	1·0	(0·8–1·2)
Gasteropod Molluscs	1·5	(1·2–1·9)
Cephalopod Molluscs	3·3	(2·8–3·8)
Decapod Crustaceans	3·6	(2·1–4·4)
Tunicates	1·7	(1·2–2·3)
Elasmobranchs	4·6	(3·1–6·4)
Teleosteans	19·1	(14·6–25·0)

These results show conclusively that neither the postulate of Krogh's theory, nor consequently its reasoning, can be correct: the blood of Teleosteans has a colloid osmotic pressure only a little inferior to that of the blood of the large terrestrial mammals (horse: 22·5–29·0 cm. H_2O).

What is the explanation of the difference of colloid osmotic pressure of the different animals? An answer to this question is suggested by the striking differences between Elasmobranchs and

Teleosteans. It is well known that not only the skeleton, but also the circulation, respiratory and excretory systems of these two classes of fishes are very different. I incline to the conclusion that the colloid osmotic pressure of the body fluids of an animal is but an expression of its general organisation. With one exception, all the values recorded above can be arranged in the order of phylogenetic development. The only exception to this rule not only does not weaken this argument, but even strengthens it: adult Tunicates are animals degenerated by fixation; their organisation is comparable to that of the gasteropod Molluscs; the colloid osmotic pressure of their hæmolymph has indeed the same value as that of this class of animals.

PAUL MEYER.

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Tamaris-sur-Mer,
and
Laboratoires Lumière, Lyon.
Oct. 16.

[1] *Ergeb. Physiol.*, 34, 18; 1932.
[2] "Anatomy and Physiology of Capillaries". 2nd ed., p. 305. New Haven, 1929.

Function of the Labral Glands in *Chirocephalus*

MISS NICHOLSON and Prof. Yonge, in their letter in NATURE of October 12, claim to have obtained experimentally the same results that I described[1] from the study of sections of fixed material of the Fairy shrimp, *Chirocephalus diaphanus*. They maintain that they have demonstrated that what I described as the coagulated labral gland secretion is, in fact, the contents of the gut regurgitated as a result of the action of the fixative. But what are the facts? They fed an animal on carmine and then fixed, or rather, killed it, by placing it in a solution of Bouin, and observed that during this process its gut showed a periodic antiperistalsis by which the gut was emptied through the mouth. Now while Bouin is an excellent fixative for isolated pieces of tissue, it is a very bad fixative for an active animal of the size of *Chirocephalus* as it takes far too long to act. I tested it last week and found that one specimen was wriggling violently after a minute, and even after two minutes was still jerking its half-dead limbs. Is it surprising therefore if, during its death struggle, it vomits?

The killing agent in which my animals were fixed was a boiling saturated solution of corrosive sublimate, and it is, without doubt, the high temperature rather than the chemical which produces the coagulation of the tissues. Now in this solution fixation is instantaneous. Even if this word is objected to, it must be admitted that the first parts of the animal to be fixed will be the outer parts, which would include any secretion around the mouth, the mouth parts and the œsophagus. Hence even if, during the 'split' second while fixation is taking place, the animal desired to regurgitate, it would find the way blocked by a fixed œsophagus. On the grounds, therefore, of the totally different technique employed, it is difficult to see why any similarity should be expected between the results obtained in the two cases.

Miss Nicholson and Prof. Yonge go further and maintain that sections of their animal "revealed no essential difference between the distribution" of the regurgitated food and the mass of material that I described as the secretion of the labral glands. Prof. Yonge very kindly lent me his sections, and I was able to see at once that, on the contrary, they show no real similarity.

I described the arrangement of the coagulated mass as extending backwards from a mass underneath the head region and mouth parts beyond the tip of the labrum where it is sucked against the inner surface of the first two pairs of trunk limbs. *In this latter region "it forms a blanket over the anteriorly directed food current converting the anterior part of the food groove into a functional tube"*. The tube so formed makes its exit around the sides of the labrum through the coagulum. Further, in the *atrium oris*, that is, in the region where the labral glands open, I described the coagulum as a diffuse scattered mass extending to the actual mouth. Now is it likely that a *Chirocephalus* could regurgitate the contents of its gut and arrange them in this complicated manner? Apart from this, however, the sections which Prof. Yonge sent me showed merely a very large mass of material, *completely* filling the *atrium oris* and the food groove as far back as the sixth trunk limb, and even entering the inter-limb spaces, so that it appeared on the wrong side of the filter setæ. There was no trace of the functional tube which I described in detail and illustrated by photomicrographs. The sections showed, in fact, just what one might expect from the crude technique employed. I have photographed the critical sections and can supply copies to anyone interested for comparison with the photographs published in my own paper.

The *a priori* reasons given by Miss Nicholson and Prof. Yonge for opposing my views appear to be based on an erroneous idea of the anatomy of the labral glands and even of the function in forms where this has been established. They state that "All the unicellular glands of the 'Entomostraca', including the labral glands, have essentially the same structure" and suggest that they all produce "a substance of low surface tension which sets as a *hard cement* on contact with water". But Ostracods are included among the 'Entomostraca' and in this group there is one genus, *Conchoecia*, which is classified on the differences between its unicellular glands, while there are many Ostracods the labral glands of which produce a luminous secretion, and this can scarcely be described as a cement. More important, however, is the fact that the labral glands of *Chirocephalus* are *not* unicellular. Sections of well-fixed material show at once that they are complex structures (Cannon, 1922)[2] quite different from the other glands occurring on the trunk limbs and food groove. In fact, it is doubtful if the labral gland of any Branchiopod is unicellular.

H. GRAHAM CANNON.

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[1] Cannon, *Proc. Roy. Soc.*, B, 117, 455; 1935.
[2] Cannon, *Quart. J. Mic. Sci.*, 66, 213; 1922.

Persistence of Sperms to a Later Mating in *Gammarus*

MRS. SEXTON'S recent criticism[1] of my views on the above subject gives me an opportunity of citing further evidence in their favour. So far as I can see, only three explanations of the appearance of the anomalous black-eyed individual (for particulars see my previous note[2]) are possible: that a reverse mutation had occurred, that the individual had been accidentally introduced owing to careless technique, and the one advanced at the time (fertilisation of a single egg by sperm persisting from a previous mating).

No certain data exist on the frequency of mutation in *Gammarus*, but white-eye, the most mutable locus in *Drosophila*, only changes once in about 300,000 individuals, and no mutation has ever been seen in the laboratory in *Gammarus*. Yet a number of curious cases of the type given in my previous note[2] have been observed by different workers. It therefore seems unlikely that they are due to reverse mutations.

With regard to the second possibility. It is the rule in Oxford, as in Plymouth, to give the female in a cross mating a fresh bowl, etc., after her moult. Pipettes are always well washed out and examined, and where possible dried, before being used for another stock. In these circumstances, I consider it very unlikely that the results are due to contamination from other pots.

Fortunately there is in this case definite positive evidence for the third explanation, for the anomalous individual appeared a whole day before the rest of the brood, strongly suggesting that the egg from which it arose had been fertilised before the rest. I do not know how much, if any, of the lining of the oviduct is shed at the moult, but I think that the possibility of sperm persisting in the mesodermal region, and fertilising one egg on its way to the brood-pouch cannot be excluded, and is much the most reasonable explanation of the results observed.

Mrs. Sexton suggests that if this explanation were true, all the genetic work so far done on the species would be valueless. An added precaution is always taken in this laboratory to ensure the authenticity of the offspring. It is clearly necessary to discard the first family, which may have been in the pouch before the female was mated up, but here either the *next* brood is also discounted or some other precaution to the same effect is taken, and little doubt can be cast on results on this score.

With regard to the statement that Mrs. Sexton had never met a comparable case, it may be mentioned that only in a proportion of instances could the persistence of sperm in this manner be detected.

K. W. YARNOLD.

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Comparative Anatomy,
Oxford.
Oct. 15.

[1] E. W. Sexton, NATURE, 136, 477, Sept. 21, 1935.
[2] K. W. Yarnold, NATURE, 135, 832; 1935.

Overlapping of Speech Sounds

THE piece of sound film reproduced in Fig. 1 shows the last part of the vowel and the first part of the consonant in a registration of *ash*. The vibratory bits that characterise the vowel can be traced in ever-diminishing strength to the third line in the reproduction. The mixture of regular and irregular vibrations that characterise the consonant can be traced back to the middle of the first line. The end of the vowel and the beginning of the consonant are seen to be overlapped.

Fig. 2 reproduces macrophonic registrations of the pressure of the breath at the mouth during *a*, *sh*, *e*, *s* and *ashes* spoken on one occasion. Comparison shows that the word *ashes* was spoken with the sounds *sh* and *s* slightly overlapped, and the two vowels mounted on top of them. The overlapping is indicated by the heavy horizontal lines at the bottom of Fig. 2.

As it is not possible to produce two sounds in succession and then by a reversal of time push the later one forward, the overlapping must occur before the sounds are spoken. This indicates that the central—or inner—activity that originates what is spoken has not only dimensions of time and pro-

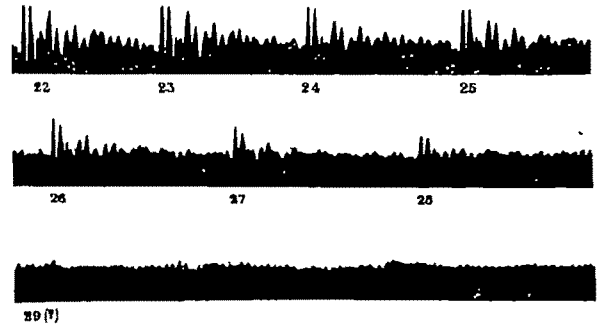

FIG. 1.

minence but also a dimension of breadth that provides for simultaneous events.

The overlapping clears up a mystery. It is well known that the character of a speech sound may depend on a sound that appears later in the printed word. How a sound could work backward against

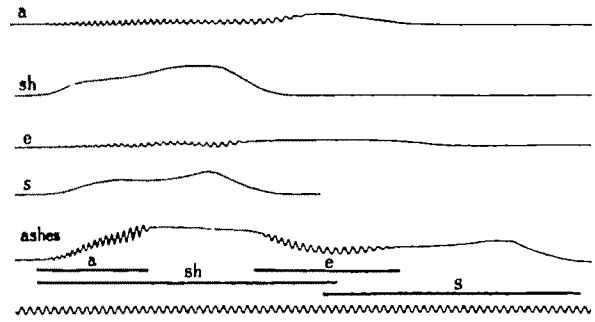

FIG. 2.

time was unexplainable. The difficulty disappears if sounds can be overlapped in the word to be spoken. This principle may well prove fertile in explaining the phenomena of sound change.

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Origin of the Wing accompanying the Rayleigh Line in Liquids

IT has been recently reported by Gross and Vuks[1] that, in the light scattered by some organic crystals, there are a few lines or bands very close to the Rayleigh line. The origin of these lines has been attributed to lattice oscillations in the crystals. It has been further pointed out by these authors that these lattice oscillations persist even in the liquid state, but, owing to the looseness of the oscillations in the liquid state, these lines spread out so as to form a continuous wing on both sides of the Rayleigh line. According to these authors, the major portion of the wing is thus due to the persistence of these lattice oscillations in the quasi-crystalline groups present in the liquid, and only the portion very close to the Rayleigh line which increases in intensity with

the rise of temperature may be connected with the rotation of the molecules in the liquid. If this hypothesis be correct, the intensity of the portion of the wing very close to the Rayleigh lines should increase and that of the other portions should diminish on dissolving a liquid in a solvent which itself gives a very feeble wing, because the quasi-crystalline groups of the solute should disappear or at least their number should diminish considerably in the solution.

The wing due to cyclohexane is very feeble in comparison with that due to benzene. In order to test the above hypothesis, the distribution of intensity in the wing due to benzene on the Stokes side of the Rayleigh line 4046 A. has been compared with that due to a 40 per cent solution of benzene in cyclohexane. The exposures in the two cases were so adjusted that the Raman line 990 cm.$^{-1}$ of benzene was of the same intensity in the two spectrograms, and also the cyclohexane lines were so feeble that the wing due to cyclohexane was totally absent. A Fuess spectrograph producing absolutely no coma on the Stokes side was used. The microphotometric records of the spectrograms due to pure benzene and the mixture are reproduced as Figs. 1 (*a*) and 1 (*b*) respectively.

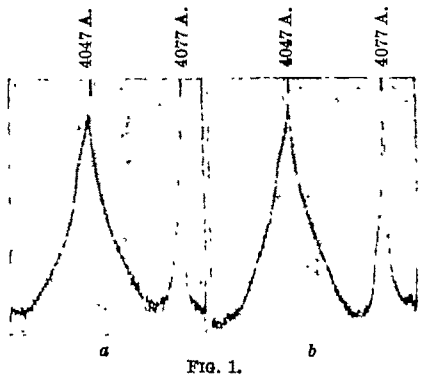

FIG. 1.

It will be seen from these figures that on dissolving benzene in cyclohexane, the intensity of the portion of the wing very close to the Rayleigh line *diminishes*, while that over a short region from about 50 cm.$^{-1}$ from the centre of the Rayleigh line *slightly increases*, and also the total *width of the wing remains practically unchanged*. These facts are contradictory to the hypothesis of Gross and Vuks mentioned above. In fact, the intensity of the portion of the wing very close to the Rayleigh line diminishes also with the rise of temperature in the case of benzene[2].

It may be briefly mentioned here that the Raman spectra of diphenyl ether and naphthalene in the solid and liquid states and also dissolved in cyclohexane have been studied by me, and it has been observed that the width of the Raman lines or bands lying very close to the Rayleigh line in the case of the solid state increases only slightly in the case of solution. The intensity of the strongest of these lines diminishes *only slightly* in the case of diphenyl ether and *considerably* in the case of naphthalene on dissolving these substances in cyclohexane. These facts suggest that these lines are not due to lattice oscillations but may be due to oscillations of very small groups of molecules which are more stable in the case of polar than in the case of non-polar molecules. These points will be discussed in more detail in a paper which will be published shortly in the *Indian Journal of Physics*.

My thanks are due to Prof. D. M. Bose for his kind interest in the work.

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92, Upper Circular Road,
Calcutta.
Sept. 20.

[1] NATURE, 135, 100, 431; 1935.
[2] S. C. Sirkar and B. B. Maiti, *Ind. J. Phys.*, 9, 323; 1935.

Back to Minkowski

A REVIEW of my recent work on "Relativity" appeared in NATURE of October 19 under the above title. There is just one reference which might give a wrong impression, namely, where the reviewer says that the author of the work considers "that the apparent regression of the nebulæ may be interpreted as a progressive diminution in the velocity of light". This evidently refers to an article which I contributed to *Engineering* in 1933 and which I had reprinted as Appendix IX of the book in question.

I wish to point out that the implication of the article in question was not to suggest the explanation given but to make it clear that no experiment that could be devised would distinguish between an expansion of the universe and a progressive diminution in the velocity of light. I advanced no argument or theory in favour of one or the other. Philosophically the question is one involving the relativity of magnitude.

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Oct. 25.

THE reference which Dr. Lanchester thinks may give a wrong impression was founded on his Appendix IX, interpreted by the aid of p. x of the preface —"the later discussion (Chapter xiii), in which the doctrines of general curvature and expansion are discredited"—and of pp. 13 and 124—"it is clearly without meaning to talk of the expansion of the Universe unless some part of the Universe be excluded from the general expansion with which to make comparison, and then it is no longer an expansion of the Universe". If my interpretation was wrong, I must express my regrets.

H. T. H. P.

South and East African Stone Age Typology

IN my letter in NATURE of September 21, p. 475, in the fifth paragraph, I said that the oscillation which marks Bed III at Oldoway and the Intrapluvial in Pluvial II, in Uganda, "may be equated with that between the Kamasian and Gamblian" of Kenya. That was wrong, for it has recently become clear that following the Uganda Pluvial II oscillation, and separated from it by a considerable thickness of sediments, there were two less marked breaks. Study of the implements from these two non-pluvial beds reveals the fact that the last actually represents the break equivalent to that between the Kenya Kamasian and Gamblian pluvials, since in it were

some tools (Late Acheulean) comparable to the Nanyukian. The latter stage was found by Dr. J. D. Solomon on the slopes of Mount Kenya in a rubble which was regarded as marking the Kamasian-Gamblian Interpluvial.

Therefore, the first climatic break in Pluvial II, Uganda, and as recorded in Bed III Oldoway, was a much earlier affair than I suggested.

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Kampala, Uganda.
Oct. 19.

Kelvin and the Age of the Sun

WHEN the age of the sun is discussed, it is often assumed that Kelvin asserted quite dogmatically that the age of the sun could not exceed 20,000,000 years. It is well, however, to turn to his own words on "The Age of the Sun's Heat" in a lecture printed in *Macmillan's Magazine* in 1862 and reprinted in his "Popular Lectures and Addresses" (vol. 1), published by Messrs. Macmillan and Co. On p. 368, he wrote that it seemed most probable that the sun had not illuminated the earth for 100,000,000 years and almost certain for not exceeding 500,000,000 years. "As for the future, we may say, with equal certainty, that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life, for many million years longer, unless sources now unknown to us are prepared in the great storehouse of creation." The concluding words display the prescience of this great man of science, much of whose work has now become so familiar that we have forgotten that it had ever to be brought into being.

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Tynemouth.
Sept. 21.

Points from Foregoing Letters

THE average time that an atom of phosphorus spends in the body of a rat which has been fed with sodium phosphate is about two months. This is the conclusion to which O. Chiewitz and Prof. G. Hevesy have come by feeding rats with small quantities of sodium phosphate containing radioactive phosphorus as indicator, and analysing the excreta of the animals and their organs after death. The authors further believe that the formation of the bones is a dynamic process, involving continuous loss and replacement.

By the bombardment of magnesium with α-particles, Dr. C. D. Ellis and W. J. Henderson have obtained, in addition to aluminium of mass 28, already known, two other radioactive products. One of these emits electrons of 11 min. period and the other positrons of 5–7 min. period; the authors suggest that these two radioactive products are, respectively, aluminium of mass 29 and silicon of mass 27.

H. J. Walke suggests that potassium of mass 43 should have a radioactivity of less than 16 hours, which is the radioactive period of potassium of mass 42; it could not, therefore, account for the long-period radioactivity of ordinary potassium. This has been attributed by Newman and Walke and by Klemperer to radioactive potassium of mass 40, and H. J. Walke now directs attention to recent publications supporting this latter hypothesis.

An electron density map of a molecule of resorcinol is given by Dr. J. Monteath Robertson. This is the first example of an organic molecule which has yielded to quantitative X-ray analysis without the aid of symmetry components in the molecule itself. The complete structure is determined, and it is shown that the hydroxyl groups belonging to adjoining molecules approach to within 2·66 A., indicating the presence of hydrogen or 'hydroxyl' bonds between the molecules.

A suitable method for preparing colloidal dispersions of a cancer-producing substance, dibenzanthracene, for injection into experimental animals and for tissue cultures, has long been desired. H. D. Barnes describes such a method, in which he employs lecithin, a constituent of egg-yolk, as dispersing agent.

Further analysis of the amino acids which, according to Prof. A. I. Virtanen and T. Laine, are excreted in the soil by nodules of leguminous roots, have convinced these investigators that aspartic acid, which they failed to find on a previous occasion, is a constituent of the amino acid mixture. The remainder apparently consists of lysine. The authors believe that these compounds are the primary amino acids formed in the fixation of nitrogen by leguminous plants.

According to experiments by Dr. Paul Meyer, the colloid osmotic pressure of the body fluid of marine animals shows a close relationship to their general organisation. The values obtained with serum of Teleosteans are nearly as high as those of large terrestrial mammals. The assumption of Krogh that aquatic animals should require only a low colloid osmotic pressure in the blood to prevent filtration is not confirmed by the author.

Miss Nicholson and Prof. Yonge, disagreeing with Prof. H. Graham Cannon's views as to the function of the labral glands of the fairy shrimp, *Chirocephalus*, have stated that the material described by Graham Cannon as coagulated gland secretion was in fact the regurgitated contents of the gut. Graham Cannon now answers that there are essential differences between the coagulated mass described by him and that observed under different conditions by Nicholson and Yonge.

Sound-film tracks and breath-pressure records of speech-sounds, submitted by Prof. Scripture, indicate that successive speech-sounds may overlap one another in the spoken word. This may explain how the character of a speech sound can depend upon a sound that appears later in the printed word.

The outer portions of the 'wings' accompanying the Rayleigh line in the Raman spectrum of the light scattered by certain organic liquids such as benzene have been ascribed by Gross and Vuks to the persistence of quasi-crystalline lattice oscillations, rather than to the rotation of the molecules. Dr. S. C. Sirkar points out that one may then expect the intensity of the outer portions of the wings to diminish when benzene is mixed with a liquid like cyclohexane, which has feeble 'wings'. This, however, he finds does not occur.

Research Items

Neolithic Civilisation of Manchukuo

As part of the work of the Japanese first scientific expedition to Manchukuo, archæological investigations, not however of an intensive character, were carried out in the province of Jehol. Some twenty-four sites in southern Jehol produced results, mainly pottery, but associated with implements of chipped or polished stone. In a report on the results of this reconnaissance by Ichiro Yawata (Rep. of the First Scientific Expedition to Manchukuo, June to October, 1933, Sect. 6, Pt. 1, Waseda University, Tokyo. In Japanese with summary in English) the pottery is classified into four main groups: (i) yellowish-brown and dark brown of rather coarse fabric, some plain, but a large proportion with cord-marked or banded ornament; (ii) grey, brown or black ware of fine paste, wheel-made, with slip, and polished and in some instances with painted designs; (iii) grey, bluish or black, wheel-made, and baked to a fine texture, commonly known as Han type pottery; (iv) reddish-brown, of fine texture, containing a large proportion of talc powder. The distribution of the groups varied, but on most of the sites examined two or three of the groups were present and sometimes all four. So also polished as well as chipped stone implements were found sometimes on the same site. At Ho-Tung, Chen-teh, on a hillock on which relics were found from foot to summit, quantities of groups i and iii with small quantities of ii and iv were associated with spindle-whorls, chipped and polished stone axes and stone knives; and on a hill to the north-west of Lwang-ping, with groups i, iii and iv, stone knives, a grattoir, and some pieces of iron were found. The axes collected included one perforated specimen. Near Pei Piao a fragment of a bronze vessel was discovered. This appears to have had a high ringed foot. The bottom was divided into three panels, each with a double dragon design. An analysis gives a composition of copper, 66·98; tin, 8·62; lead, 21·64; nickel, 0·05; arsenic, trace. The results of chemical and metallurgical examination point to a pre-Han origin.

Methods of Psychodiagnosis

Character and Personality (3, No. 3) contains an article entitled "The Development Test as Applied to Infants in the Service of Psychodiagnosis" by Hildegarde Hetzer and Anneliese Braun, Educational Academy, Elbing. It gives a short report of the Vienna developmental tests carried out by Ch. Bühler, H. Hetzer and others. With these tests, consisting of seventeen series each containing ten tasks, they claim to "provide one means for the psychodiagnosis of infants useful for pediatricians, psychologists, educationalists and practitioners of healing methods for children". They check the performances of one to six years' old children in six chief lines of human behaviour: sensory perception, body control, sociability (language), learning capacity (memory and imitation), capacity to deal with a given material, intellectual productivity. The quantitative degree of development in each of these at a certain age is noted. Thus they find the developmental quotient in the same way as one finds the intelligence quotient. This quotient indicates "a general habit" and not inborn efficiency in a limited field of behaviour alone. An analysis of three practical cases illustrates the method. The results are checked by a doctor's opinion and general observation. They throw light on character traits and factors influencing character and personality, reveal errors of everyday judgment and give hints for therapy.

American Ground Squirrels and Pneumonic Plague

THE most extensive outbreak of plague among ground squirrels since the peak of the animal epidemic in California between 1907 and 1919 is being experienced on the west coast of the United States. Dr. W. H. Kellogg states that not only is ground squirrel infection not decreasing after thirty years, but rather it is increasing and spreading over a wider territory, so that from the Coast Range it has penetrated to the interior valleys of California and even to the Sierras (*J. Amer. Med. Ass.*, Sept. 1935). Thus a permanent endemic rodent focus has clearly become established. Equally disturbing is the fact that the plague shows renewed virulence and an increasing pulmonary tendency in the prevailing strain of the plague bacillus, and pneumonic plague, more deadly to man than bubonic, is thought to be directly related to the plague in ground squirrels and ground hogs. Once pneumonic plague has obtained hold in highly populated human areas, its spread becomes independent of ground squirrel or the flea which acts as carrier, because the bacilli are in the sputum and transfer may take place by droplet infection.

A Remarkable Dipterous Insect

THE discovery of a remarkable type of fly in Japan by Mr. M. Tokunaga was announced by him in 1932, when he gave it the name of *Nymphomyia alba*. Since this insect did not come within the limits of any known family of Diptera, the new family Nymphomyiidæ was established for its reception. Mr. Tokunaga's preliminary paper appeared in *Annotationes Zoologicae Japonenses* of 1932 and a brief account of this communication appeared in our columns (NATURE, 132, 68; 1933). In the *Philippine Journal of Science*, February 1935 (pp. 127–210), the same writer contributes a long and detailed study of this insect's morphological features. Although *Nymphomyia* possesses brachycerous antennæ, it is regarded as belonging to the series Nematocera on the basis of the wing venation and other general characters. Its specialisation isolates it from any known families of Diptera, and on the whole, its primitive features mark it as being among the lower assemblage of the order. A study of its larval structure is greatly needed and, until this is available, definite conclusions as to its nearest affinities lack an important possible link in the evidence. A very peculiar feature of the insect is that the wings are deciduous, being easily broken off along a definite line, as in termites and ants. Whether or not this is a normal occurrence in life is as yet undetermined.

Sense-Organs of Spiders

Two almost simultaneous papers make a noteworthy contribution to our understanding of the sense-organs on the legs of spiders. B. J. Kaston (*J. Morphol.*, 58, 1, 189–207; 1935) describes the histological structure of the lyriform or slit organs, and concludes that they probably function as chemoreceptors, stimulated by odorous vapours. They closely resemble the sensilla on the antennæ of insects. In an exceptionally interesting paper, H. Blumenthal (*Z. Morphol. Okol. Tiere*, 29, 5, 667–719; 1935) has made a full histological and experimental study of the tarsal organ first noticed by Dahl in 1883. This organ, which lies dorsally on the tarsi of legs and palpi in both sexes of all but a few families, appears, like the slit-organs, to react to vapours. Spiders were found to respond to the arrival of a drop of water by approaching and drinking it, but this did not happen if the tarsal organ was excised. The organ may also function as a detector of taste, for spiders were apparently able to distinguish between pure water, sugar solution and brine. It is suggested that its chief biological value is in the search for drinking-water, in the finding of a mate and in the tasting of captured prey. The organ is comparable in structure to the Haller's organ of the ticks and the chemoreceptors described by Minnich on the legs of insects.

Growth and Moulting of Lobsters

KNOWLEDGE of the development of lobsters is a matter of great importance, for legislation fixing size limits and close seasons ought to be founded upon the natural history of the species. Some observations upon the growth of young lobsters have been made by W. C. Smith at Port Erin Marine Biological Station (*Trans. Liverpool Biol. Soc.*, 48, 51; 1935), though the fact that the conditions were artificial warns against acceptance of the results as of general significance. It was found that moulting and mortality in lobsters from about a year to 2½ years old were almost confined to the summer months, with temperatures above 10° C., and that death rate reached a maximum with temperature. Moulting occurred from two to five times during the second year, generally three times; and two or three times in the third year. After the fifth to the eleventh year there is only one moult annually. Sizes were, at end of first growth period, 26–32 mm., at end of second year 42–57 mm., in autumn of third year 70 mm., but the numbers measured were very small. One female lobster was ten years old before reaching the legal fishery size of 9 inches, although a male of five years may reach the legal size for catching after next moult.

Pruning of Mature Apple Trees

MANY apple growers continue to prune mature trees as a matter of routine. It has been assumed that pruning is an indispensable foundation for fruitfulness in trees of all ages, but the conclusions expressed in a recent publication by Joseph Oskamp (Bull. 624, Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y., March, 1935) do not support this view. The bulletin handles a formidable collection of detailed records, extending over a period of twelve years, which refer to trees about twenty-five years old. No significant effect of pruning on yield of fruit, or on its size, colour and freedom from blemish has been found. It is suggested that mature trees should merely be kept within bounds, so that the fruit is not difficult to gather, and that sufficient attention be given to the mechanical ability of branches to bear heavy loads of apples. The need for light at the centre of the tree also makes it necessary to remove whole branches as they tend to fill up the space within the crown of the tree too tightly.

Methods of Orientation in Ancient Babylonia

DR. ECKHARD UNGER appends to an account of ancient Babylonian maps and plans which have survived on clay tablets certain indications of the methods of orientation emerging from their examination (*Antiquity*, September). A world map, for example, shows, especially by the 'dark' fifth region in the north, that the north-west was at the top of the map. It has been shown that the Sumerians originally based their system on the direction of the prevailing winds in Mesopotamia, these being approximately north-west, north-east, south-east, south-west. They determined the individual character of these winds, and interpreted them as manifestations of gods of a like nature. The manifestation of the gods through the winds played an important part in the orientation of the temples set up to them, but owing to wind variation, the direction was the arc of a quadrant. The rising of the sun in the north-west quadrant at the summer solstice was the time for determining orientation in Babylon, the run of the streets, etc., affording an astronomical time-gauge, occurring once a year and providing a basis for the adjustment of the calendar by an intercalary month. The moon and stars also afforded systems of orientation; but in all the system was inclined, and did not follow the cardinal points as we understand them. This shows that the tradition of a deity associated with the wind survived. In practice, owing to wind variation, orientation was checked by the position of certain stars. 'Sunrise' and 'sunset' imply a similar orientation by quadrant, indicating not the direct easterly or westerly points, but the complete quadrant within which the sun rose or set.

Seismology in New Zealand

SOME interesting reports on earthquakes in New Zealand have recently been published. Dr. C. E. Adams and Dr. J. Henderson describe the earthquakes of the year 1934 (Dominion Obs. Bull. No. 102; 1935), twenty-four in number, one of which, on March 5, was of destructive intensity. Its epicentre lay in lat. 40·95° S., long. 176·8° E., about thirty miles off the east coast of the North Island. The earthquake caused considerable damage in the south-east portion of the North Island, and slightly disturbed the face of the country in the districts round Pahiatua and to the east. Dr. L. Bastings (Bull. No. 103) gives a list of the destructive earthquakes in New Zealand during the century 1835–1934. They are sixty-nine in number, six of intensity 10, fourteen of intensity 9 and forty-nine of intensity 8 (Rossi-Forel scale). Taking account of earthquakes of all three intensities, the author claims for New Zealand a seismicity twice as great as that of Japan. Mr. R. C. Hayes (Bull. No. 104) considers the annual and diurnal frequency of earthquakes in New Zealand. For all earthquakes (1848–1934), the maximum number occurs in June, and for strong earthquakes (intensities 7–10) during the hours 0–3 a.m.

Oxidation of Metals

G. D. PRESTON and L. L. BIRCUMSHAW (*Phil. Mag.*, Oct.), working at the National Physical Laboratory, have investigated the oxide films found on metals and alloys at low temperatures up to 400° C., using electron diffraction patterns to identify the thin films produced. The oxide film on copper, formed at room temperature, at 100°, and at 183°, showed the structure of Cu_2O, the thinner films showed a marked tendency to orientation with a (111) plane parallel to the polished surface of the metal, but orientation disappeared with the thicker films. A brass (30 zinc : 70 copper) formed a Cu_2O film at 183° C. and ZnO at 400° C., an aluminium brass gave a film of Cu_2O, the absence of any record of Al_2O_3 being ascribed to the amorphous nature of the substance. Magnesium and its alloys gave cubic films of MgO. It is suggested that the orientation observed with Cu_2O (and less markedly with MgO) is such that the plane in the oxide having the higher density of metal atoms tends to lie on the polished surface.

Absorption of Short Wave-Lengths

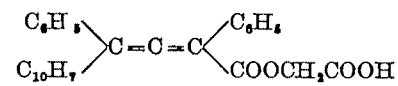
IN a paper published by the Bangalore Press on the transparency of the atmosphere in the ultra-violet and a possible means of extending the solar spectrum in the region 2200–2000 A., K. R. Ramanathan and L. A. Ramdas, of the Meteorological Office, Poona, have collected together many of the results obtained by different workers on the absorption of short wave-lengths by various agencies, particularly by oxygen and ozone. In the light of these results, they discuss the possibility of extending the solar spectrum beyond the limit attained up to now in the ultra-violet, which limit is stated to be 2863 A., reached by Paul Gotz in Switzerland. Measurements of the absorption coefficients for ozone suggest that if the sun radiates as a black body at about 6,000° Abs. there should be a revival of the solar spectrum beyond the Hartley absorption band at about 2200 A. if ozone is the only absorbing agent. Herzberg, one of the investigators of the absorption of very short wave-lengths by oxygen, has suggested that the failure to detect any such revival is due to absorption by oxygen. This paper analyses some of the measurements of transparency of long horizontal columns of the atmosphere of the order of 1,000 metres that have been made by various workers, and a table is given which shows the absorption coefficient between 2893 A. and 1855 A. after the effects of haze, molecular scattering and ozone have been allowed for approximately, based on measurements by Jausseran and Rouard. In another table are shown the values of the intensity of solar radiation at 2900, 2200, 2063 and 2000 A. at the surface, at 16 km. and at 20 km., assuming that the sun radiates as a black body at 6,000° Abs., that the quantity of ozone in the atmosphere is 0·2 cm. at normal temperature and pressure, that the absorption coefficients for ozone below 2300 A. found by Meyer in 1903 are correct, and that the coefficients for atmospheric air are those found by Buisson, Jausseran and Rouard. The figures suggest that at 16 km. the solar spectrum might be photographed beyond 2200 A., if spectrographs of the same power as those used at the surface could be employed, but that it is very doubtful whether we could go beyond 1950 A. It is pointed out that a height of 16 km. is attainable by sounding balloons and even by manned stratosphere balloons.

New Kinetic Theory of Gases

IN the "Physics Forum" of the September issue of the *Review of Scientific Instruments*, Dr. I. I. Rabi of Columbia University directs attention to the new experimental facts with respect to gases which have been discovered by the use of molecular beams, and to the revision of the kinetic theory of gases which these facts have rendered necessary. While the hard sphere picture of the collision of two molecules is retained, wave mechanics requires the addition to it of a de Broglie plane wave of wave-length equal to Planck's constant h divided by mv, where m is the reduced mass $m_1m_2/(m_1+m_2)$ and v is the relative velocity of the two molecules. The effective area of the collision cross-section is changed from the πa^2 of the older theory to $4\pi a^2$ for small relative velocities and to $2\pi a^2$ for high velocities. The mean free path thus becomes a function of the temperature of the gas as well as the pressure, and there is no necessity to assume an attractive force between the molecules, which formerly meant the introduction of an assumed constant into the theory. The author concludes that the molecular radii and laws of force between molecules deduced from the older theory "have no real basis in fact".

Resolution of an Allenic Compound

IT is now known that allenic compounds in which at least one of the hydrogen atoms on each of the terminal carbon atoms of allene has been replaced by a substituent, can be obtained in optically active forms (Mills and Maitland, NATURE, **135**, 994; 1935). Another example is furnished by the resolution of an allenic acid:



by E. P. Kohler, J. T. Walker and M. Tishler (*J. Amer. Chem. Soc.*, **57**, 1743; 1935). The acid was first prepared by Lapworth and Wechsler in 1910, in one of the earliest of the many attempts to prepare an allenic compound suitable for resolution. The acid chloride has now been prepared, and also the glycolic acid derivative, which was resolved by means of the brucine salt. The acid, which melts at 195°, is a racemate or racemic mixture of two optical opposites which melt at 145°–146° and in ethyl acetate have the rotation $[\alpha]_D = 29{\cdot}5°$.

Late Type Variable Stars

IN the October *Observatory* (**58**, 285), Mr. A. D. Thackeray contributes an article on the observational facts which are known about the late type variable stars. We have here a field of astronomical work in which an enormous wealth of observational material is at hand with which theory has been unable to deal adequately. The complexity of the variations in magnitude, radial velocity and in spectral phenomena is very great, and there are many features which present grave difficulties to any attempts at a theoretical explanation. In particular, the presence of bright lines in the spectra is very difficult to account for in view of the very low temperatures of these stars, and the most hopeful line of attack must be an explanation in terms of chemical luminescence. This article should prove very useful, as it gives a summary of the known facts, with extensive references to the original works.

Theories of Vision

By Dr. F. W. Edridge-Green, C.B.E.

THOUGH the subject of theories of vision has been under discussion for many years, it has been suggested to me that a useful purpose would be served by a statement of the case for the visual purple theory in comparison with the duplicity theory. The visual purple view is that the cones are the sole percipient elements of the retina, being stimulated by the photochemical decomposition of the liquid surrounding them, the rods not being percipient elements but nerve elements regulating the supply of visual purple to the liquid surrounding the cones. Direct stimulation of the colourless transparent cones is against all photochemical laws, and these colourless transparent cones are surrounded by a highly absorbent photochemical substance, the visual purple, which when decomposed must produce an effect.

Visual purple was found in liquid form in the retina surrounding, but not in the cones, by Devereux Marshall and me with monkeys' retinæ examined immediately after removal of the eyes. This experiment is supported by the fact that Kuhne found visual purple in a fluid form in the retina and poured it out on a plate.

There are numerous physiological facts, as, for example, the control of vision by the nervous system, the removal of waste products and the resensitisation of the cones, which are inexplicable on a direct stimulation hypothesis[1]. If the rods and cones were distinct percipient elements there should be a distinct qualitative difference between the portion of the retina containing only cones and that containing rods, but von Tschermak, Hering, Hess, Garten and others have found only gradual quantitative differences in the sight between the foveal and the extra foveal area. The Purkinje phenomenon, the alteration of optical white equations by the state of dark adaptation, the colourless interval for spectral lights of increasing intensity, the different phases of the after-image, all exist, not only in the extra foveal, but also, only gradually diminished, in the foveal region. In certain conditions the colour of the positive after-image of any colour or white is purple[2].

Helmholtz pointed out that the evidence only proved that the cones were percipient elements and that there was no evidence that the rods were percipient elements. At a later date this view was reaffirmed by Nagel.

The eye resembles a photographic apparatus, and actual photographs have been taken on the retina and fixed by Kuhne. It will be noted that on the duplicity theory there is a very unsatisfactory correspondence with the film of a photographic apparatus. Photographers know that the sensitiveness of this film must be under control and a different sensitiveness is required for different intensities of light, but on the duplicity hypothesis there is only a mechanical arrangement. Bauer has shown that the visual purple is regenerated more rapidly under the stimulus of light than it is in absolute darkness, so that it must have a function in the daytime. If, however, we suppose that the function of the rods is to regulate the sensitiveness of the photographic film, that is to say, they are the nerve elements which liberate the visual purple into the liquid surrounding the cones, making this film more or less sensitive in accordance with the requirements of vision, we have an explanation of every known fact of vision.

The decomposition of the visual purple surrounding the cones causes stimulation of the cones and a visual impulse is set up. It is difficult to see how from the stimulation within the cone hypothesis the waste products can escape and a cone return to a condition in which it is able to receive further stimulation. It is probable that even in the early forms of vision, stimulation of the nerve ends took place not through the direct stimulation of the nerve end by light but indirectly through some light-absorbing substance which when acted upon by light gave off products which stimulated the nerve end. This appears to be the case even with the vision of insects.

The following are given as facts supporting the duplicity theory :—(1) that certain animals have only cones and others have only rods ; (2) that the periphery of the retina is colour-blind ; (3) that the eye is totally colour-blind in dark adaptation ; (4) that the Purkinje phenomenon and the recurrent image are not found with the fovea ; (5) that Porter-graphs consist of two branches, one the branch corresponding to light above 0·25 metre-candle, corresponding to the cones, and the branch for light below 0·25, corresponding to the rods. With regard to these, I make the following comments :—

Though I have examined numerous collections, I have never been able to find any animal with only rods or only cones, neither have I met anyone who has seen such a retina. The tortoise is the most quoted ; it is stated to have only cones. The rods and cones in the retina of the tortoise are as clearly defined and distinct as in the human retina. The periphery of the retina is not colour-blind when colours of sufficient intensity are used. This can readily be tested with a doctor's red lamp, which, it will be found, can be seen as red to the extreme periphery. In dark adaptation the eye is not totally colour-blind. Further, there is no scotoma or blind area corresponding to the rod-free portion of the macula which is equal to a visual angle of about three degrees. The Purkinje phenomenon and recurrent image are found with the fovea.

Frank Allen states that in his experiments all branches of the Porter-graphs were obtained on the same central area of the retina where rods are fewest in number or are altogether absent, the flickering at the point of fixation being specially noted. The presence of *B* branches in the graphs obtained under these conditions is therefore quite adverse to the duplicity theory. The larger number of branches of the Porter-graphs and their identification with enhancing and depressing reflex actions seem to remove the graphs completely from their support of the duplicity theory.

Secondly, facts which are explained in some measure by the duplicity theory can be explained in a far better manner by the visual purple theory. For example, the Purkinje phenomenon is found with other photochemical substances so that it is only a photochemical phenomenon. The visual purple gives a curve which is very similar to that of many other photochemical substances. We know that with photochemical substances the chemical effect is not proportional to the intensity of the light: a different curve is obtained with weak light from that which is formed with light of greater intensity. It is reasonable, therefore, to suppose that the visual purple which is formed by the pigment cells under the influence of a bright light would be somewhat different in character from that which is formed in darkness. Again, from the chemical analogy just given, even if the visual purple were of the same character we should not expect similar curves with different intensities of light. It is probable that both factors are in operation.

On the duplicity theory, the decomposition of the visual purple is supposed to stimulate the rods directly, but what other organ in the body produces a secretion which stimulates itself?

The fact that a small star is seen more clearly on the para-foveal region than with the foveal region has been given as a strong fact supporting the duplicity theory, but the yellow pigment of the yellow spot has been entirely overlooked. This absorbs light, particularly blue, and would account for the phenomenon. Pertz has shown that the dark adapted fovea is more sensitive to red light than the periphery, and yet red light bleaches the visual purple. Again, the most sensitive portion of the dark adapted retina forms an oval with its long axis horizontal, the oval being ten degrees in its vertical axis and fifteen to twenty degrees in its horizontal axis. This is just at the edge of the yellow spot where there are few rods. If this were a rod phenomenon, the light should appear much brighter farther out where the rods are much more numerous. The phenomenon is also found with the light adapted eye. If two discs of white paper each of a diameter of a sixteenth of an inch be pasted on black cardboard an inch apart and viewed from a distance of twelve to eighteen inches it will be found that the one that is directly looked at (with one eye) appears much darker and yellower than the other.

Congenital night blindness has been supposed to be due to absence of rods, but a better explanation is that the cones are not so sensitive as normal to a feeble stimulation, especially as this condition can be produced by continuous exposure by day to a bright light, as, for example, that reflected from snow. Congenital day blindness has been supposed to be due to absence of the cones, but a better explanation is that the mechanism of light adaptation is defective, probably from defective development of the rod and cone apparatus. This is supported by the fact that many of these persons see red imperfectly, and the rods are not supposed to convey impulses leading to the perception of colour.

In light adaptation, more visual purple is used up, but more is formed. In dark adaptation, though less is formed, much less is used up and so accumulates in the peripheral regions. The sensitisation of the foveal region from the periphery appears to be directly under the control of the nervous system.

We now come to facts which are inexplicable by the duplicity theory: the presence of visual purple in liquid form in the retina and surrounding but not in the cones; the fact that vision is plainly under the control of the nervous system is not explained.

At one moment the fovea appears the least sensitive portion of the retina and at the next moment may be the most sensitive portion of the retina. Helmholtz, whilst recording the fact, confessed that he was quite unable to suggest an explanation. The following simple experiment illustrates this:—On opening an eye on awaking in the morning and looking at the ceiling the central portion is seen as an irregular, circular, rhomboidal or star-shaped black spot. On closing the eye again a bluish violet circle appears at the periphery or middle of the field of vision, contracts and then after breaking up into a star-shaped figure and becoming brighter disappears, to be followed by another contracting circle. If the eye be opened when the star figure has formed in the centre it will appear as a bright, rose-coloured star, much brighter than any other part of the field of vision. If, however, we wait until the star has broken up and disappeared before opening the eye, it will be found that only a black spot is seen in the centre. This is explained on the theory that when there is visual purple in the fovea this is the most sensitive portion of the retina; when there is none there it is blind. It also shows that the fovea is sensitised from the periphery.

There are numerous methods by which currents in the field of vision which are not due to the circulation can be seen. The currents carry the visual quality, colour and brightness of the region from whence they come into an after-image. They also tend to move an after-image towards the centre; if we have two similar after-images, one situated in the centre and the other a short distance from the centre, the one external to the centre may be carried into the centre and combine with the one already there. These currents are formed by the flow of sensitised liquid.

The following simple experiment shows the influence of the para-foveal regions on the foveal region of the retina. Let a piece of black cardboard eight inches square be taken and place this on a wallpaper with a coloured pattern. The light in the room should not be too bright. The black cardboard should be viewed with one eye at a distance of six feet, the eye being kept as immovable as possible. It will then be noticed that portions of the colours of the wallpaper will appear to detach themselves from the wallpaper and move with a slow spiral motion into the black area. This will go on until the whole black area has completely disappeared, the surface being covered with a mixture of colours similar to those on the wallpaper.

There are numerous variations of the experiment. If a piece of yellow paper be placed on a blue ground and viewed as above, it will be noticed that the blue will invade the yellow until the latter appears quite white and then gradually becomes blue.

The bending of the re-current image at the fovea discovered by Hess is not explained by the duplicity theory. The duplicity theory fails to explain the change in position in the field of vision of after-images on movement of the eye.

The cones, therefore, are the sole percipient elements, and on being stimulated start impulses which are conveyed along the optic nerve to the brain and stimulate certain cells of the visual centre causing a sensation of light, and other cells causing a sensation of colour.

[1] "The Physiology of Vision" (G. Bell and Sons, 1920). "Science and Pseudo-Science" (Bale, 1933).
[2] NATURE, 136, 302, Aug 24, 1935.

Molecular Structure of Carbohydrates

THE British Association discussion at Norwich on September 5, in Section B (Chemistry), on the molecular structure of carbohydrates, following the presidential address to the section, revealed both the variety of the important problems which still await solution, and the diversity of methods now employed in the attack on these problems. The discussion was opened by Prof. W. N. Haworth, president of Section B, whose presidential address constituted a survey of the present position of polysaccharide chemistry. It was shown that the recognition of the pyranose structure of ordinary glucose —a discovery barely ten years old—led the way in the elucidation of the ring structures of the disaccharides and afterwards of the polysaccharides.

Cellobiose (4–β–glucopyranosido-glucopyranose) and maltose (4–α–glucopyranosido-glucopyranose) are of special importance respectively in the chemistry of cellulose and of starch. Both these polysaccharides consist essentially of chains of glucopyranose units linked through positions 1 and 4, the glucosidic link being α– in starch and β– in cellulose. Chains of glucopyranose units appear also in glycogen and in lichenin. In xylan there occur chains of β–xylopyranose residues; and chains of manno-pyranose units (mutually linked through positions 1 and 6) and galactopyranose units (linked through positions 1 and 4) occur in polysaccharides synthesised *in vivo* by the action of certain moulds on glucose solutions. All the above are of the pyranose type, but the furanose structure is also found in polysaccharides, and recent work shows that its occurrence is widespread. An arabofuranose unit forms the terminal portion of the xylan molecule; chains of fructofuranose units with mutual linkages in the 1 : 2 positions constitute inulin, whereas fructofuranose units linked through positions 2 and 6 are found in levan, an important bacterial polysaccharide, and in a closely related polysaccharide which occurs in grass.

The work of the Birmingham school has, however, gone beyond the elucidation of the molecular structures of the polysaccharides and has succeeded in determining by purely chemical methods the molecular size of the giant molecules. For example, by gravimetric assay of the tetramethyl glucose formed on hydrolysis of the fully methylated polysaccharide, the chain-length of methylated cellulose has been fixed at 100–200 glucose units, and that of starches of diverse botanical origin at 26–30 units. Use of this 'end-group' method has served for the allocation of chain-lengths to glycogen, xylan, inulin, levan, and other polysaccharides. In many examples, this chemical molecular weight is in striking disagreement with the figure obtained on the basis of Staudinger's viscosity method, and the causes for this divergence were discussed with particular reference to the important case of the amylose and amylopectin constituents of starch, in which aggregation of the macro-molecules takes place. Special emphasis was laid on the need for clear differentiation between the chemical molecule and aggregates of such molecules which function as physical units.

Other methods of attack on the problem of molecular weights are also being employed, and in a subsequent paper Dr. S. R. Carter described results of osmotic pressure measurements on methylated and acetylated derivatives of inulin and lichenin. One of the principal difficulties in the use of this method lies in the choice of suitable semipermeable membranes, but by use of a disc of 'viscacelle' of adjusted porosity in specially designed apparatus, accurate measurements of osmotic pressure were obtainable. The figures for inulin were of particular interest, since they are in complete agreement with the chemically determined chain length (30 fructose units), whereas the viscosimetric measurements indicated only one-third of this value (10 units). In this case the failure of the viscosity method may be connected with the special conformation of the fructose units in the polysaccharide molecule.

Prof. Haworth's address concluded with a reference to investigations which have been commenced on the constitution of plant gums. These are of particular interest in that a derivative of gum arabic is known to possess properties resembling those of the specific polysaccharide of Type III pneumococcus anti-serum. The recent discoveries of such polysaccharides having immunological properties are of great importance, and the elucidation of the chemical structure of these substances must be of the greatest possible service to medicine.

In the paper which followed, Dr. W. T. J. Morgan discussed the function of polysaccharides in immunological specificity. He described the early discoveries concerning the specific precipitant for pneumococcus antibacterial immune serum, which led to the recognition that the capsular substance, different for each kind of bacterium, contains a complex polysaccharide which is the specific agent responsible for the serological reactions of the organism with the homologous antibody. Considerable progress is being made in inquiries into the chemical location of the specific characteristics, and it appears that the latter depend upon (*a*) the nature and stereochemical arrangement of the component sugars; (*b*) the mode of linkage of the sugar residues; and (*c*) the nature and position of substituent groups in the sugar residues. The mode of combination by which the reducing group of a glycuronic acid molecule forms a glycosidic union with the terminal primary alcoholic group of a glucose (or galactose) molecule, appears to have special significance in immunological chemistry. In addition, the specific properties of the polysaccharide-protein complex are closely governed by the presence in the polysaccharide of appropriately situated substituent groups, such as acetyl.

The two remaining papers were concerned with the intimate structure of the simple sugars. Dr. E. L. Hirst considered the possible correlation of structure with optical rotatory power in the sugar group. Although many empirical rules relating structure and rotation have been enunciated, their validity is always severely restricted to a small group of substances, and exceptions are frequent. It was shown that measurements of the rotatory power in the ultra-violet region of the spectrum sometimes give clues to the causes of departures from the rotation-rules. Three typical problems were discussed. (*a*) The abnormal rotations in the mannose series of

sugars were found to be ascribable entirely to the mutual influence of the two *cis* hydroxy groups on C_2 and C_3. (*b*) The negative rotations of tetramethyl γ-mannonolactone in organic solvents were explained by the nature of the rotatory dispersion, which requires for its representation a two-term Drude equation with terms of opposite sign, the induced term being positive both in water (where the lactone rule is obeyed) and in organic solvents. (*c*) The sign of the induced term in the rotations of amides can be correlated with the configuration of C_2 for those substances which obey the amide-rule, but exceptions occur which necessitate special explanations.

Mr. E. G. Cox gave an account of recent progress in the crystallography of carbohydrates. X-ray studies of a number of simple and methylated sugars lead to the conclusion that the six-atom ring in the pyranoses, unlike the hexamethylene ring, does not possess the Sachse form, but contains five nearly co-planar carbon atoms, the oxygen atom being displaced out of their plane. Various chemical and physical properties of carbohydrates find a satisfactory explanation in terms of this ring conformation; for example, there is much evidence that hydroxyl groups which, according to the Haworth structural formulæ, are *cis*, are actually contiguous in space. This is true for the ring form deduced from the X-ray data, but it is by no means necessarily so with a Sachse ring.

The configuration on the first carbon atom of the cyclic forms of the sugars is not established by the same rigid methods which are applied to the remainder of the molecule; the confirmation by X-ray methods of the configurations usually ascribed to the α- and β-forms of glucose is therefore a matter of considerable importance.

Educational Topics and Events

CAMBRIDGE.—At Emmanuel College, Dr. T. S. Hele, fellow of the College and University lecturer in biochemistry, has been elected into the mastership.

A. C. Bartlett, of Emmanuel College, has been approved for the degree of Sc.D.

P. H. Blair, of Emmanuel College, has been appointed an assistant lecturer in archæology and anthropology.

EDINBURGH.—The Rockefeller Foundation has made a grant of £1,500 to the Department of Medical Chemistry, to provide for the expenses of Prof. Barger's research work on vitamin B_1, for a period of three years from October 1935.

It has been agreed to offer accommodation in the University for the meeting of the International Union of Geodesy and Geophysics, which is to take place in Edinburgh on September 15–26, 1936.

SHEFFIELD.—The following appointments have recently been made: Prof. C. J. Patten, formerly professor of anatomy, and Prof. Miles H. Phillips, formerly professor of obstetrics and gynæcology, as emeritus professors; Dr. H. A. Krebs, as lecturer in pharmacology; Mr. H. E. Collins, as lecturer in mining; Dr. M. Ritchie, as assistant lecturer in chemistry; Mr. J. Harwood, as research assistant in fuel technology; Dr. J. W. Rodgers, as Ironmongers' Company research fellow (for one year).

Science News a Century Ago

Meeting of the Medico-Botanical Society

THE first general meeting of the session for 1835–36 of the Medico-Botanical Society was held on November 10, Earl Stanhope being in the chair. After the reading by Dr. Sigmond of an eulogium on the character of the late Gilbert Burnett, professor of botany to the Society, Mr. C. Johnson delivered a lecture on the importance of botany to medicine. He contrasted the present knowledge with that of the practitioner of former days, and dwelt on the necessity of giving to the vendor of drugs an education superior to what they had and of making the study of botany indispensable.

The Paris to St. Germain Railway

THE first railway to be authorised in France was that from Paris to St. Germain, and on November 14, 1835, the *Athenæum* said of this line that it "is to commence near the Church de la Madelaine on the Boulevards, and afterwards pass through a tunnel under the Commune of Les Batignolles Monceaux. This tunnel will be 907 yards in length. There are to be three stations for receiving and delivering luggage. The number of bridges or viaducts to be erected over streets and roads, between the point of departure and the Seine will be twelve. Altogether, it is considered that this railroad will be one of the best constructed, and most useful of any yet projected, not excepting those now in progress in England. It is expected, that the steam carriages on this road will be able to travel at the rate of thirty miles an hour, and according to this calculation, the distance between Paris and St. Germain will be performed in twenty-four minutes. It now occupies one hour and forty minutes."

Darwin at Tahiti

ON November 15, 1835, H.M.S. *Beagle* arrived at Tahiti, where she remained until November 26, when she sailed for New Zealand. Both Capt. FitzRoy and Darwin wrote interesting accounts of the island and its people, and Darwin said:

"I was pleased with nothing so much as with the inhabitants. There is a mildness in the expression of their countenances which at once banishes the idea of a savage; and an intelligence which shows they are advancing in civilisation. . . . On the whole, it appears to one that the morality and religion of the inhabitants are highly creditable." Of those who attacked the work of the missionaries among the islanders and its effect, he said: "They forget, or will not remember, that human sacrifices, and the power of an idolatrous priesthood—a system of profligacy unparalleled in any other part of the world—infanticide a consequence of that system—bloody wars, where the conquerors spared neither women nor children—that all these have been abolished; and that dishonesty, intemperance, and licentiousness have been greatly reduced by the introduction of Christianity. In a voyager to forget these things is base ingratitude. . . ."

On November 26, when the ship sailed, Darwin wrote: "In the evening, with a gentle land-breeze, a course was steered for New Zealand; and as the sun set, we had a farewell view of the mountains of Tahiti—the island to which every voyager has offered up his tribute of admiration."

Societies and Academies

PARIS

Academy of Sciences, October 7 (*C.R.*, 201, 573–628). LOUIS LAPICQUE: The nomenclature of chronaxies modified by the action of the nerve centres. Reasons are given for rejecting the terms static chronaxy and dynamic chronaxy. F. GANTMACHER and M. KREIN: Oscillatory matrices. RENÉ DE POSSEL: The abstract derivation of functions of ensembles. VLADIMIR BERNSTEIN: Concerning the methods of search for singular points of functions defined by Dirichlet series. ARNAUD DENJOY: Minkowskian functions. PAUL MONTEL: A theorem of Jacobi. EDOUARD CALLANDREAU: Corrective functions in the neighbourhood of the Rankine-Lévy solution of the heavy massif supported by a rectilinear wall. SERGE NIKITINE: Suction by volumetric pumps. Discussion of the relations between the yield of a pump and the number of strokes per minute. MIROSLAV NÉNADOVITCH: The influence of the inter-inclination of one of the wings on the aerodynamic characteristics of rigid biplane cells of infinite span. ANDRÉ COUDER: The cellular construction of telescope mirrors. The deformations observed in cellular mirrors are much larger than would be expected from a study of the elastic properties and are probably due to the thermal conditions existing during polishing. MAURICE DÉSIRANT and JULES DUCHESNE: A new emission spectrum of sulphur in the photographic infra-red. MLLE. YVETTE CAUCHOIS: New measurements and observations relating to the *L*-emission spectrum of platinum. V. DOLEJŠEK and M. HYLMAR: The fine structure of the L_{III} absorption discontinuity of the rare earths. GABRIEL VALENSI: The kinetics of the oxidation of metallic wires. M. BOBTELSKY and MME. BOBTELSKY-CHAJKIN: The catalytic decomposition of hydrogen peroxide in the presence of mixtures of salts of manganese and copper. MME. MARIE FREYMANN and PAUL RUMPF: The absorption spectra in the near infra-red of amines and amides. Use of the phenomenon of dissimulation in the search for amphoteric ions. The influence of neighbouring groups. The presence of an absorption band at $1{\cdot}04\,\mu$ is taken as a proof of the existence in a compound of the NH group. JEAN TIMMERMANS and GUSTAVE POPPE: The mutual solubility of heavy water and organic liquids in systems possessing a curve of negative saturation. MARIUS SAUVAGEOT and EDMOND ROUSSEAU: The transformation points of nickel steels. At the beginning of the transformations produced by heating, nickel steels undergo a very marked segregation: the first portions of austenite formed are highly charged with nickel, corresponding to a metal the transformation point of which is below 0° C. Manganese may give rise to similar phenomena. VLADIMIR FROLOW: The dissolved salts in the Sandjak waters. The electrical resistance of twenty-five waters from various sources has been studied as showing the variations in the content of dissolved salts. PIERRE DANGEARD: The identity of *Laminaria Lejolisii* and *L. iberica*. PIERRE P. GRASSE and MLLE. LOUISE LESPERON: The accumulation of acid colouring matters in the silkworm by different tissues according to the mode of access. GEORGE BEADLE and BORIS EPHRUSSI: The differentiation of the colour of the *cinnabar* eye in *Drosophila melanogaster*. A. PAILLOT: A new ultra-virus disease (polyhedra disease) in the larvæ of *Vanessa urticæ*. V. A. KOSTITZIN: A relation between the sex and the number of parasites in the same host. A mathematical study of the data on this subject given by A. Vandel. MME. PAULETTE CHAIX: The kinetics of the attack of glucose and of lactic acid by small bacterial masses. The idea of minimum active mass.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 517–559, Sept. 15). CLAUDE E. ZOBELL: The assimilation of ammonium nitrogen by *Nitzschia closterium* and other marine phytoplankton. Provided small concentrations (0·2 millimol and less) of ammonium, nitrite and nitrate are compared, multiplication of the diatoms first becomes manifest with ammonium nitrogen. In cultures containing both ammonium and nitrate, the ammonium was the first to be depleted, and a trace of nitrite appeared. It is suggested that the diatoms in the sea reduce nitrate to nitrite extracellularly in the course of nitrogen assimilation and that nitrification, hitherto regarded as an essential to nitrogen assimilation, is rather a regulatory or storage process. G. A. MILLER: Groups in which the squares generate a subgroup of index less than seven. A. D. MICHAL: "Riemannian" differential geometry in abstract spaces. E. FISHER: Asymptotic representations of confluent hypergeometric functions. A. D. MICHAL and V. ELCONIN: Completely integrable differential equations in abstract spaces. CHARLES H. FAY: A refinement of the Heisenberg theory of ferromagnetism, applicable to simple cubic crystals. The micro-crystal is regarded as built up of units larger than the atom but containing sufficiently few atoms to allow calculation of their unperturbed energy levels. The method treats half the interaction rigorously, instead of none as previously, and the remainder by an average energy approximation similar to that used in the 'simple' Heisenberg theory of ferromagnetism. E. HUTCHISSON, T. H. OSGOOD and R. E. FEARON: Electrical conductance of short gaps in air. Apparatus was devised whereby two nearly flat surfaces could be brought into gradual contact, and very small potential differences, below the ionising potential of the common gases of the air, were used in order to avoid sparking. It was found that appreciable current can pass surfaces of approximately 4 cm. diameter separated by 10,000 A. in air, and that the current is proportional to the square of the applied potential difference, suggesting conduction by charged dust particles. When the plates are brought gradually closer, the current changes from an ionic to an ohmic one, the latter being probably due to metallic prominences on the opposed surfaces. SVEN PH. CARLSON: The colour changes in *Uca pugilator*. If the eye-stalks of the fiddler crab are removed, the animal becomes pale, an effect the reverse of that which occurs in most crustaceans. Extracts from the middle part of the eye-stalk of the crab cause the animal to grow dark again. The active substance seems to come from the blood-gland of Hanström and is probably the eye-stalk hormone common to crustaceans, though its effect on the fiddler crab is the reverse of that on other crustaceans. JANE M. OPPENHEIMER: Processes of localisation in developing *Fundulus*. By means of localised vital staining, it has been possible to trace the position of embryonic tissues and the movements by which their cells attain their final position. TRUMAN L. KELLEY: An unbiased correlation ratio measure.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 10

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. A. T. Hopwood: "Fossil Mammals".*

Monday, November 11

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—J. D. Macdonald: "Birds".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. G. Barbour: "The Evolution of the Yangtze Kiang".

Tuesday, November 12

BEDFORD COLLEGE FOR WOMEN, at 5.15.—C. A. Mace: "The Experimental Study of Incentives".*

KING'S COLLEGE, LONDON, at 5.30.—H. W. Dickenson: "The History of Mechanical Invention" (succeeding lectures on November 19 and 26).*

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. A. Smithells: "The Teaching of Chemistry" (Harrison Memorial Lecture).

Wednesday, November 13

BRITISH SCIENCE GUILD, at 4.30.—(at the Goldsmiths' Hall, Foster Lane, London, E.C.2).—Sir Josiah Stamp: "The Calculus of Plenty" (Norman Lockyer Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Sir Albert Howard: "The Manufacture of Humus by the Indore Process".

Thursday, November 14

ROYAL SOCIETY, at 4.30.—G. L. Brown and Sir Henry Dale: "The Pharmacology of Ergometrine".

M. J. D. White: "The Effects of X-Rays on Mitosis in the Spermatogonial Division of *Locusta migratoria*, L."

D. E. Sladden: "Transference of Induced Food Habit from Parent to Offspring".

ROYAL ASIATIC SOCIETY, at 4.30.—Dr. M. Gaster: "Maimonides and his Works".

CHEMICAL SOCIETY, at 8.—Dr. S. I. Levy: Brauner Memorial Lecture.

Friday, November 15

ROYAL SOCIETY OF MEDICINE, at 8.15.—Discussion on "The Recent Epidemic of Malaria in Ceylon", to be opened by Sir Weldon Dalrymple-Champneys, Dr. Wigglesworth and Dr. P. H. Manson-Bahr.

ROYAL INSTITUTION, at 9.—Prof. Robert Robinson: "The Synthesis of a Natural Colouring Matter".

Official Publications Received

Great Britain and Ireland

The Journal of the Institute of Metals. Vol. 56. Edited by G. Shaw Scott. Pp. 306+31 plates. 31*s.* 6*d* net. Metallurgical Abstracts (General and Non-Ferrous). Vol. 1 (New Series). Edited by G Shaw Scott. Pp. vi+780. With Vols. 54 and 55 of the Journal, £4. (London: Institute of Metals.) [1910

Malvern College Natural History Society. Twelfth Report, 1935. Pp. 36. (Malvern: Malvern College.) 1*s.* [2110

Ministry of Health. Housing Act, 1935. Memorandum A: General. Pp. 19. 4*d.* net. Memorandum B: The Prevention and Abatement of Overcrowding. Pp. 30. 6*d.* net. Memorandum C: The Redevelopment of Overcrowded Areas. Pp. 11. 2*d.* net. Memorandum D: Financial Provisions. Pp. 8. 2*d* net. Memorandum E: Consolidation of Housing Conditions and Accounts. Pp. 24. 4*d.* net. (London: H.M. Stationery Office.) [2310

Miscellaneous Publications of the International Tin Research and Development Council. No. 3: The Functions of a Technical Information Bureau By Dr. E. S. Hedges and Dr. C. E. Homer. Pp. ii+8. (London: International Tin Research and Development Council.) Free. [2310

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1651 (T. 3603) Comparative Measurements of Turbulence by Three Methods. By the Staff of the Aerodynamics Department, National Physical Laboratory. Pp. 17+8 plates. 1*s.* 3*d.* net. No. 1652 (T. 3582): Experiments on Servo-Rudder Flutter. By Dr. W. J. Duncan, D. L. Ellis and A. G. Gadd. Pp. 30+8 plates. 2*s.* net. No. 1654 (T. 3455 revd.): Spinning of a Bristol Fighter Model including Effect of Wing Tip Slots and Interceptors. By H. B. Irving, A. S. Batson and J. H. Warsap. Pp. 19+14 plates. 2*s.* net. No. 1655 (F.M. 194): Statistical Measurements of Turbulence. By Dr. H. C. H Townend. Pp. 10+4 plates. 9*d.* net. (London: H.M. Stationery Office.) [2310

The National Smoke Abatement Society. Sixth Annual Report, 1935–1936. Pp. 30. (Manchester: National Smoke Abatement Society.) [2410

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1934. Vol. 69, Part 1: Acreage and Production of Crops and Number of Live Stock in England and Wales. Pp. 91. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [2510

Other Countries

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 5: List of Publications on Indian Entomology, 1933. Compiled by the Officiating Imperial Entomologist, Pusa. Pp. ii+29. (Delhi: Manager of Publications.) 9 annas; 1*s.* [2110

Report of the Twenty-second Meeting of the Australian and New Zealand Association for the Advancement of Science, Melbourne Meeting, January 1935 Edited by G. W. Leeper. Pp. xlvii+561+10 plates. (Sydney: Australian and New Zealand Association for the Advancement of Science.) [2110

Department of Agriculture: Territory of New Guinea. Bulletin No. 2 (Leaflet 70): The Possibility of Developing an Economic Cacao Industry in the Mandated Territory of New Guinea after a Study of the Industry in Trinidad, and a Suggested Policy for that Development. By E. C. D. Green. Pp. 72+2 plates. (Canberra: Commonwealth Government Printer.) [2110

Forest Bulletin No. 91: Damage by Frost at New Forest, Dehra Dun, during the period 1930 to 1934. By Bachaspati Nautiyal. Pp. iii+18+4 plates. (Delhi: Manager of Publications.) 12 annas; 1*s.* 3*d.* [2110

Tanganyika Territory. Mining Publicity Pamphlet. Issued by the Department of Lands and Mines. Pp. 45. (Dar es Salaam: Government Printer.) 50 cents. [2110

Bulletin of the Buffalo Society of Natural Sciences. Vol. 17, No. 1: New Fossils from the Western New York Devonian. Pp. ii+45+8 plates. (Buffalo, N.Y.: Buffalo Society of Natural Sciences.) [2110

Egyptian University. Bulletin of the Faculty of Science, No. 1: Transpiration and Stomata in Desert Plants. By A. H. Montasir and A. M. Migahid. Pp. 33. Bulletin of the Faculty of Science, No. 2: The Development of the Adult Mid-Gut of Coleopterous Insects and its bearing on Systematics and Embryology. By Dr. K. Mansour. Pp. ii+34+5 plates. Bulletin of the Faculty of Science, No. 4: Egyptian Freshwater Algae. By A. A. El-Nayal. Pp. vi+106+1 plate. Bulletin of the Faculty of Science, No. 5: A Preliminary Study of the Egyptian Soil Fungi. By Younis S. Sabet. Pp. ii+29. (Cairo: Egyptian University.) [2110

Polar Årboken 1935. Utgitt an Norsk Polarklubb. Pp. 163. (Oslo: Gyldendal Norsk Forlag.) [2210

Proceedings of the Academy of Natural Sciences of Philadelphia Vol. 87. The Occurrence of Flints and Extinct Animals in Fluvia, Deposits near Clovis, New Mexico. Part 1: Introduction, by Edgar B. Howard; Part 2: Age of the Clovis Lake Clays, by Ernst Antevs. Pp. 299–312. Descriptions of New Birds from Bolivia, with Notes on other Little-known Species. By M. A. Carriker, Jr. Pp. 313–341. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [2510

India Meteorological Department. Scientific Notes, Vol. 6, No. 64: Some Observations on the Thermal Structure of Cumuliform Cloud. By Flt.-Lieut. R. G. Veryard. Pp. 87–112. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.* [2510

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 58: Certain Aspects of Investigations on Black-end Disease of Bananas in Australia. By Shirley Hoette. Pp. 22+1 plate. (Melbourne: Government Printer.) [2610

University of California Publications in Botany. Vol. 17, No. 5: Critical Notes on C. D. Darlington's "Recent Advances in Cytology". By John Belling; with reply by C. D. Darlington. Pp. ii+75–110. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1*s.* 3*d.* net. [2810

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 44: The Commercial Fish Catch of California for the Years 1930–1934, inclusive. By the Staff of the Bureau of Commercial Fisheries. Pp. 126. (Terminal Island, Calif.: California State Fisheries Laboratory.) [2810

Thirteenth, Fourteenth and Fifteenth Annual Reports of the Research Council of Alberta, 1932, 1933, 1934. (Reports Nos. 28, 29 and 32) Pp. 87. (Edmonton, Alba.: Research Council of Alberta.) [2810

Catalogues

Watson's Microscope Record. No. 36, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

Catalogue of Important and Rare Books on Ornithology, Zoology, Botany and Geology, including a fine collection on Indian and Oriental Birds from the Library of E. C. Stuart Baker. (Scientific List 36.) Pp. 32. (London: Harrods, Ltd.)

Coleoptera. (No. 87.) Pp. 145–310. (Den Haag: W. Junk.)

Edwards' Really Rigid Universal Clamp. (List B2.) Pp. 2. Edwards' Rotary Blower and Vacuum Pump Type IV. (List G.2.) Pp. 2. (London: W. Edwards and Co.)

The Newton British-made Epidiascopes. Pp. 24. (London: Newton and Co.)

Galvanometers, Photographic Recording Apparatus, Galvanometer Accessories. (Section G. 33.) Pp. 47. (Delft: P. J. Kipp en Zonen.)

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Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3446 SATURDAY, NOVEMBER 16, 1935 Vol. 136

Food and the Nation

IN those wonder-promising days of the Victorian era, when all seemed well with the world because the *beati possidentes* alone were vocal, there appeared to be general agreement that the functions of the State should be confined to upholding justice, to protecting citizens against aggression, and to providing certain public health services, such as sanitation and preventing the spread of epidemics. As time went on, State intervention was extended to the provision of primary education, old-age pensions, health insurance and unemployment benefit; but it is only recently that the scandal of the slums has compelled Parliament to assist in providing decent housing accommodation for the poorer classes. Last of all, there is now a clear call for the State to take a hand in providing adequate food for the million.

It is strange that this most essential of all the basic needs of man should have been recognised so tardily, except for certain regulations governing chemical and bacteriological purity. It is true that there are some half-dozen Government departments dealing with certain aspects of national nutrition; but there has hitherto been no unified direction, no settled policy and no legislation either based upon, or in any way recognising, the principle that every man who does his duty by the community shall by legal right, and not by charity, be secured from hunger or from the ill-health associated with an inadequate dietary. To-day the word 'inadequate' applies to quality as well as to quantity, for scientific research has shown that man cannot live by calories alone; in addition to proteins, fats and carbohydrates, he needs certain essential vitamins and minerals that are largely to be found in fresh dairy produce, eggs, fruit and vegetables. Was it not Lavoisier who lamented the fact that the very people who needed most food and nutritious food—the labouring classes—were precisely those who were least able to afford it? What Lavoisier said towards the end of the eighteenth century applies with particular force to-day, especially in regard to nutritional quality.

Sir John Orr, in a remarkable address to the British Association at Norwich, told us that estimates show how in this year of grace 1935 there are some twenty million people—more than forty per cent of the population of Great Britain—who, largely owing to poverty, do not enjoy a diet which according to the modern science of nutrition is completely adequate for health, so that diseases due to malnutrition are still rife. In view of the glut of all kinds of food, this state of affairs is disturbing the public conscience. Although there is a great lack of authentic data, recent investigations by the staffs of the Rowett Institute and the Market Supply Commission indicate that consumption of milk, eggs, fruit and vegetables rises uniformly with income; and that physique is worse, and disease is more prevalent, in the poorer classes. The diet of the lowest income group—those earning ten shillings or less a head of the family each week—is markedly deficient from the point of view of health, and a minimum family income of about £1 a head each week is needed.

To bring the diet of the poorer sections of the community up to the standard required for health

would involve an increased food consumption of 10 per cent, representing at retail prices a hundred million pounds per annum, and to bring all diets up to the average of those of the income level of 25*s*. a head a week would require 20 per cent more food and two hundred million pounds greater expenditure at retail prices. The additional food, consisting mainly of fruit and vegetables, and animal products such as milk and eggs, could be produced at home without prejudicing our export trade or the interests of our overseas investments, and, of course, our agriculture would benefit greatly.

The measures that have recently been taken to encourage home food-production, by raising prices to a level assuring adequate returns to producers, suffer from the drawback that they maintain food at prices that retard consumption. Therefore they cannot be regarded as elements of a permanent policy. Sir John Orr would like to see the present marketing boards assume the role of public utility companies, which would control slaughter-houses, bacon factories, milk-depots, etc., buy from the farmer and sell to the distributing trades, making the staple foodstuffs available at a special low price to the poorest classes. Such an organisation would in itself lower retail prices by reducing distribution costs, and the rest of the gulf between the price paid to the farmer and the money received from the consumer would be bridged by a direct State subsidy. The ultimate effect of this subsidy would be to reduce State expenditure on public health and social services; meanwhile, it would promote internal trade, stimulate industries, and bring back money to the Treasury in the form of income-tax and other receipts.

Increased consumption, as Sir John says, is the crux of the problem, and in this connexion attention should be directed to that rare thing, a successful economic experiment, which was carried out early this year by the Potato Marketing Board in the depressed area at Bishop Auckland, Co. Durham*. This area has a population of 19,000, which in February last included 5,000 insured male workers, of whom 2,400 were unemployed. For a period of eight weeks in February and March, potatoes were sold to the unemployed and their dependants (33 per cent of the population) at 4*d*. per stone, as compared with the ruling price of 7*d*. per stone. Each buyer had to get a retailer to stamp a voucher, present it at a central warehouse, pay cash and take away his purchase in his own container. The Board paid to the retailer 1*d*. per stone of potatoes sold, as compensation for loss of trade, and 10*s*. per ton to the wholesale merchants for services rendered. About 94 per cent of the issued vouchers were used; 187 tons of potatoes were purchased by the Board at an average price of 59*s*. per ton, and deducting wastage, 182 tons were sold. The total expenditure of the Board (exclusive of overheads) was £297, comprising £111 for warehouse distribution, £121 for compensation to retailers (13*s*. 3½*d*. per ton of potatoes sold), and £65 for wholesale merchants. It was found that, although sales from retail shops fell to 60 per cent of the normal, total sales increased by 96 per cent above the normal, or 69 per cent if full allowances be made for loss of trade sustained by fish-fryers, and for a big reduction in sales during April. No change in the dietary of the unemployed was observed other than an increased consumption of potatoes.

The experiment may, therefore, be held to show that increased consumption of a cheap and valuable commodity like potatoes will follow a drastic reduction in price. The Board does not suggest that the method is of general application; nevertheless, as an emergency measure for the relief of the unemployed, or for disposing of surplus stocks, for example, of milk or meat, it might well receive the consideration of public bodies. Nor would it be maintained that all the evils associated with an unorganised distributive system, or those due to maldistribution in general, could be solved by such means.

One of the most important questions of the day is whether the existing economic system can be modified and amended in such manner that the satisfaction of primary human needs no longer remains subservient to the making of profits. Such schemes as that of Sir John Orr, which has been publicly approved by the Minister of Agriculture, may suffice to raise the general standard of living to a level commensurate with the abundance of supplies that modern industry, based upon modern science, has placed at our disposal, and in accordance with the dictates of the modern social conscience. Failing their success, the only alternative, short of pure communism, appears to be an amount of State control of trade and finance likely to provoke widespread opposition in a people still retaining a degree of liberty of action. After all, there seems to be no reason why, with abundance knocking at the door,

* An Experiment in the Distribution of Potatoes at Bishop Auckland, February–March, 1935. Potato Marketing Board, Miscellaneous Publications, No. 2. 1*s*.

every working citizen should not be guaranteed a sufficiency of the basic necessities of life, namely, food, housing, light and fuel, without prejudicing the interests of those who are more fortunately placed.

Those who look askance at the encroachments on personal liberty which such a policy would appear to entail, might consider the dictum of Huxley: "The only liberty I care about is the liberty to do right". Is there not a moral obligation on the part of the State to ensure the bare minima of the means of subsistence to all who render service to it? And what a brave new world might arise, what developments might follow if the thoughts of even a fraction of those who are now at their wit's end to meet the requirements of daily life could by such means be diverted into the cultural channels of art, science, philosophy and letters! Many no doubt will urge that it is one thing for the State to provide such means towards a fuller life, but quite another for men to use them in the way intended. The answer to that contention is that man, in the mass, has not yet been given the opportunity, and that his future progress depends primarily upon his ability to master and improve his environment, and to provide the young with the best all-round education that his wits can devise.

Original Sources in Physics

A Source Book in Physics

By Prof. W. F. Magie. (Source Books in the History of the Sciences.) Pp. xiv+620. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

TWO great efforts to present to the physicist and chemist the *ipsissima verba* or translations of some of the fundamental contributions to science come to mind as one turns the pages of this latest 'source book'—Ostwald's *Klassiker* and the publications of the Alembic Club. He is fortunate who has easy access to a full set of the *Klassiker*—its hundred-odd reprints represent a remarkable attempt to collect in one group those contributions to the advancement of the physical sciences which may be regarded as classic. The publications of the Alembic Club are fewer in number and more restricted in character—they cover certain of the classics of chemical science—and it is interesting to note that a term has not yet been set to the activities of the Club, as reprints, sponsored by Dr. Leonard Dobbin, are still appearing under its name.

It is, perhaps, impossible to consider the publication in English of a series of reprints covering so wide a field as Ostwald has surveyed, and until such a venture becomes possible, we must be content with the very good second-best which Prof. Magie has provided for us. He has shown conclusively—and some of his audience were inclined to be sceptical about it—that it is possible to give something of the atmosphere of a physical paper by selections, brief enough to keep his book within moderate compass, yet chosen so as to illustrate the central thesis of a theoretical analysis or the essentials of a piece of experimental work.

The main sections of the book are headed mechanics, properties of matter, sound, heat, light, magnetism and electricity; selections from some one hundred and fifty papers are given; and the authors range, in time, from Stevinus, Galileo, Huygens and Newton, to Maxwell, J. J. Thomson, Zeeman, Röntgen and the Curies. A brief account of the life of an author precedes the selection from his papers.

The selections are far from being snippets; they convey something of the method and outlook of the author, and they provide a reference book which serves to elucidate certain obscure and doubtful passages in the ordinary texts. Once again we are privileged to hear Boyle telling how he took "a long glass-tube which, by a dexterous hand and the help of a lamp, was in such a manner crooked at the bottom that the part turned up was almost parallel to the rest of the tube"; and how, having closed the shorter end of the tube, he imprisoned air therein, and "began to pour quicksilver into the longer leg of the siphon, which . . . did . . . streighten the included air: and continuing this pouring in of quicksilver till the air in the shorter leg was by condensation reduced to take up by half the space it possessed (I say, possessed, not filled) before", how he "observed, not without delight and satisfaction, that the quicksilver in that longer part of the tube was 29 inches higher than the other".

We may read for ourselves what Grimaldi really saw in 1658; and if we want to know whether Römer did or did not enunciate a sort of Doppler principle, regarding Jupiter as a body sending

signals to the earth at regular intervals, and now moving towards, now away from the earth, so that the observed intervals varied correspondingly, the evidence is before us. We have the text of Davy's experiments on friction, and we can see for ourselves that Newton's law of cooling was established for forced convection—for bodies *cooling in a breeze*.

This last paper is specially interesting ; it is brief, it was published anonymously, and its topic is that of a "Scale of Degrees of Heat". The scale is duodecimal, the zero being the temperature of freezing water, and 12° the normal temperature of the human body. Various temperatures are recorded ; 34° is the "heat with which water boils vehemently", 96° is the "least heat with which lead melts", and the highest temperature recorded (200°–210°) is the "heat of a small fire made of wood". The scale is established with the assistance of a linseed oil thermometer and red-hot iron.

The translation in the volume under review tells us that Newton "heated a large enough block of iron until it was glowing, and taking it from the fire with a forceps while it was still glowing I placed it at once in a cold place where the wind was constantly blowing ; and placing on it little pieces of various metals and other liquifiable bodies I noted the times of cooling until all these bodies lost their fluidity and hardened, and until the heat of the iron became equal to the heat of the human body". He then proceeds to determine the "heats" under review by assuming that the "excess of the heat of the iron and of the hardening bodies above the heat of the atmosphere, found by the thermometer, were in geometrical progression, when the times were in arithmetical progression".

An interesting point arises concerning the details of part of this translation. It happens that a translation of Newton's paper was appended by Robert Smith to his edition of Cotes' "Hydrostatical and Pneumatical Lectures" (3rd edition, 1775), a useful little volume which contains as an appendix, not only Newton's paper, but also Halley on the reason for the rise and fall of the barometer with change of weather, and Jurin on capillarity. Smith's translation reads, "I heated a piece of iron . . . till it became redhot, and taking it from the fire with the tongs likewise redhot, . . . upon it I laid particles . . . and noted the several instants of time when by cooling they lost their fluidity and began to coagulate. . . ." The differences are slight but significant and, accuracy apart, the existence of an almost contemporary translation raises the point whether it is not preferable to employ such a translation whenever possible, as more likely to give the atmosphere of the original.

It is impossible to give more than the slightest indication of the generous loading of the table which Prof. Magie has spread. Faraday, Ampère, Coulomb, Hertz ; Ohm, Joule, Rowland and Hall ; Stokes, Kirchhoff, Balmer and Stefan ; these are but a few of the hundred or so authors represented, and there are remarkably few omissions. In the ranks of writers now dead, Waterston should certainly have been included ; and there are some obvious omissions of the names of workers still with us.

A. F.

A New Botanical Annual

Chronica Botanica
Edited by Dr. Fr. Verdoorn. Vol. 1, 1935. Pp. 448. (Leyden: Chronica Botanica, 1935.) 15 guilders.

THIS new periodical provides abundant matter of many-sided botanical interest. When the editor put forward his general scheme there were many who thought it impossible to carry out in a satisfactory manner, but although there is considerable unevenness of treatment there can be no doubt that the result is very satisfactory. Roughly, the idea is to give the most recent information about the four thousand or so institutions concerned with pure or applied botany and the researches of the sixty or seventy thousand botanists—and to do this annually.

The volume is divided into three parts which are readily recognised by the yellow, red and blue colouring of the page edges.

The first part (75 pages) deals with a number of heterogeneous subjects. It opens with an article by Dr. E. D. Merrill on "International Co-operation among Botanists", which is a statement of general customs and a plea for their present continuance and future development. Then follows an almanac which, among other matters, gives the birthdays of many former botanists and present ones (with some age restriction) ; and an outline programme of the Sixth International Botanical Congress held at Amsterdam on September 2–9 with photographs of the Committee and Recorders and of a dozen prominent botanists who have passed away since the last Congress in 1930. Dr. T. A. Sprague then gives a brief "Survey of Nomenclature (1930–35)" mainly concerned with

the effect of the death of Dr. J. Briquet in 1931. Dr. A. B. Rendle contributes "A Short History of the International Botanical Congresses" which goes beyond the Paris Congress of 1900 and begins with the Brussels Congrès International d'Horticulture, 1864: this is the longest article in the volume, and is a most useful and interesting account of a little-known subject. It is followed by thirty-five pages giving information about "International and Important Congresses, Committees, and Societies": those who hold there are too many congresses will surely find some arguments here in favour of their opinion.

The next 258 pages form the main part of the volume. This is a "Review of all Branches of Plant Science during 1934" arranged alphabetically by countries and further subdivided alphabetically. To get the information, a set of questions was sent out. Institutions answered in different ways and at various lengths, which accounts for a good deal of the unevenness of treatment. Research programmes, changes in staff, new buildings, investigations being carried out, explorations, extensions, publications—indeed everything that might be considered of general botanical interest, or of special interest to those working in the same field. This is supplemented by information found by the editor in periodicals; NATURE and *Science* being well combed. But there are others: for example, "*Sovjetskaja Botanica* announces that botanical lectures are regularly given to the soldiers of the Red Army, who are said to be deeply interested in this new feature". This section ought to prove of the greatest value to workers in every branch of botany, for the pages are packed with information.

The last section is again heterogeneous. It begins with "Correspondence", the sixteen letters covering a wide field: there are also half a dozen queries. Two pages are devoted to new periodicals and thirty-four pages to new and changed addresses, which is really a supplement to the "International Botanical Address Book". A touch of intentional humour is provided by "A Short Illustrated History of Botany in the Netherlands" which consists of twenty-eight sketches with legends. Forty-five pages of advertisement and two indexes complete the work.

The volume is very well produced with abundant illustrations. The type, though small, is clear.

The compilation of such a mass of detailed information has meant an enormous amount of labour, and it is to be hoped that Dr. Verdoorn, who has placed botanists under an obligation, will receive the necessary help to go on with this publication. J.R.

Practical Aspects of Illumination

(1) A Symposium on Illumination
Contributing Authors: J. F. Colquhoun, W. J. Jones, J. T. MacGregor-Morris, C. C. Paterson, A. B. Read, F. C. Smith, J. W. T. Walsh, H. C. Weston, G. H. Wilson. Edited by C. J. W. Grieveson. Pp. xv+229+20 plates. (London: Chapman and Hall, Ltd., 1935.) 13*s*. 6*d*. net.

(2) Lighting Calculations
By Prof. H. H. Higbie. Pp. xi+503. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 31*s*. net.

(3) Encyclopédie photométrique
Quatrième section: Cas extrêmes. Tome 4: Photométrie des lumières brèves ou variables. Par Madame Marguerite Moreau-Hanot. Pp. iv+126. (Paris: Éditions de la *Revue d'Optique théorique et instrumentale*, 1934.) 25 francs.

THE march of progress in illuminating engineering is aptly illustrated by the three books before us. (1) The first of these, "A Symposium on Illumination", comprises a series of lectures by experts, delivered in London under the joint auspices of the National Illumination Committee and the Illuminating Engineering Society in 1933. The book covers a wide field. Mr. C. C. Paterson's initial address on "Light in the Service of Mankind" is followed by lectures on radiation, gas and electric lamps, photometry, daylight and various applications (public lighting, etc.). The book thus represents a survey of modern knowledge, in the main simple and concise. As Lieut.-Col. Kenelm Edgcumbe suggests in his foreword, it should be of interest to the non-technical, or at least the semi-technical reader. Probably, however, the chief appeal of the book will be to students, giving them an insight into a subject on which everyone ought to know something.

(2) Prof. Higbie's treatise on "Lighting Calculations", on the other hand, is primarily a book for those who make lighting their vocation. In his ten chapters, all devoted to different types, he shows how numerous and varied are the computations that enter into the treatment of lighting problems, and succeeds in answering the question set in his first chapter, "Why bother about Lighting Calculations?" The initial chapters deal with the simpler problems. Following discussions of linear

and surface sources of light, we come to what is perhaps the most usual calculation in connexion with illumination—the predetermination of illumination by the aid of the utilisation coefficient. The apparent intricacy and elaboration of the tabular data here presented is justified by the wide use that can be made of this method, which has been shown to be applicable even to installations of a highly modern and original type.

It may come as a surprise to find from other chapters that calculations may be made on such matters as glare, shadows and the sufficiency or otherwise of the illumination provided. Problems (often containing a useful reference to some specific article or paper) are presented at the end of each chapter. More than two hundred such tests are included in the book, which is terminated by a needful but adequate index.

(3) The third volume, edited by Mme. Marguerite Moreau-Hanot, is of a still more specialised character. It forms one of a series of monographs by experts, dealing with different aspects of photometry, and is devoted exclusively to the measurement of light impulses of short duration. Such matters as the perception of transient lights, persistence of vision, the use of photoelectric cells and the measurement of variable sources are discussed. In conclusion, some reference is made to television and the optical reproduction of sound. Naturally not all the matter is of an original character—some covers ground familiar to the photometric expert—but the assembly of material makes an instructive whole.

Some of the problems handled, such as the recording of variable candlepower from fluctuating sources and lights of short duration, the measurement of variable illumination, the persistence of luminous impressions and the study of the duration of phosphorescence are of considerable interest. The book takes the reader into various by-ways of photometry not ordinarily encountered.

J. S. D.

The Hake and its Fishery

The Hake and the Hake Fishery: being the Buckland Lectures for 1934. By C. F. Hickling. Pp. 142. (London: Edward Arnold and Co., 1935.) 3*s*. 6*d*. net.

THE author's interest in the hake fishery commenced when he was an undergraduate in 1923, and ever since he has been detailed to its study as an officer of the Ministry of Agriculture and Fisheries. This means that he has gone to sea on the Milford Haven and Fleetwood trawlers for two or three months every year, with occasional cruises on research vessels.

The hake is essentially a southern fish, and the English coasts are the northern part of its range, for it extends south to Senegal and, in the Mediterranean, even as far as Palestine. It is a warm water fish, and its prevalence in British waters is largely due to the extent to which the warmer currents reach our shores. Its home is in comparatively deep water, and commercial catches have been made at 450 fathoms. It is not, however, a bottom feeder, its habit being to rest on the bottom in the daytime and to come up to the midwaters for its food at night. Spawning is at 120 fathoms and shallower depths, commencing about April in the deepest waters and then gradually at lesser depths as the summer proceeds. The male spawns when four years old and the female at ten years, then sizes about 11 in. and 30 in.; but they vary, for the fish grow faster in warmer water, even though such water has less of the ultimate food (diatoms and other plants) on which all animals depend.

The female lays upwards of two million eggs, and fertilisation is in the sea-water, the eggs floating at the mercy of the currents. To a certain degree, the abundance of hake in subsequent years can be foretold by studying their numbers. In the youngest and most vulnerable stages, the food consists largely of crustaceans, but these are gradually replaced by other fish and squids, the adults having marked cannabalistic tendencies. Few ten-year fish are now caught in British waters, the large fish having decreased in the catches by 7½ per cent per annum for the last ten years—and the author does not suggest any migratory replacement from the south. This means less and less spawn being deposited on the breeding grounds to the west of the British Isles and constitutes a real danger to the fishery, the fish being caught faster than they can make good the loss of their stock by breeding and growth.

The above story is told mainly on the author's own researches. What are his remedies? At first we always seek aid from history, and that does not help us much here. In 1890, hake were hawked all over the west country at 1*d*. per lb. under the name of "Torbay salmon"; by 1900 the price had gone to 2*d*. Morley then made his voyages of

exploration and others followed; the result was the opening up of the Spanish and other southern grounds. In 1907 the price was still low, but the quantity was large and there were also some soles in the hake catches to add to the profit. Great trawler fleets for this fishery grew up in the west, and one fleet moved from Ireland. In this year the Press began to take an interest, with the result that in the next years hake entered into the 'prime fish' category, and the trawlers, while catching less, made better profits. The absence of fishing during the War stopped any decline in this and all the fisheries of the west Atlantic, our hake trawlers being mainly located in the eastern Mediterranean for mine sweeping. However, western Europe was quite alive to the problems, and the International Council for the Exploration of the Sea came together again in 1920. Hake was a major subject for discussion and inquiry, and the statistics were greatly improved. These show a steady strong demand especially for small hake, and the price far exceeds that of the related cod and haddock.

Withal there is a disturbing loss in catch which has to be stopped, while due attention must be paid to the sufficiency of breeding fish. Any young fish brought to the deck from the trawl are dead owing to the decrease of pressure affecting their air bladders. It is impossible to close grounds in the high seas, and the trawl owner must not take a cynical line—perhaps because he is getting old and thinking of retiring—in resisting the examination of his actual method of catching. The writer remembers nearly thirty years ago a series of conferences in the greater fish ports, where the size of the mesh of the trawl was always discussed. About twenty years later, the matter was considered by the British Fisheries Association, which ought never to have been killed or allowed to die. It was contended that a larger mesh to the trawl would allow many of the smaller, less marketable and much less valuable fish (per pound weight), to escape, while the trawl would clear itself of much of its 'rubbish', move more easily over the bottom, this securing more fish, and would arrive on the deck with its catch less bruised and in better condition for market. It was confidently anticipated that the industry would make its own experiments, but its psychology was antagonistic. Its energies were largely directed to new grounds, to be discovered near British coasts by the Ministry, or to fishing in greater depths, where there cannot be food to support a rich fish fauna, or to proceeding farther afield, in this latter alone (west of Greenland) success being achieved. The industry improved its trawls, but it never, so far as the writer knows, made any scientific experiment with its trawl mesh.

Now the Ministry, acting through Messrs. Davis and Hickling, have done the industry's work, as in these lectures all may read. They have by most ingenious means proved that, with a larger mesh, the smaller hake escape from the trawl while it is actually on the bottom, its contents experiencing no change in pressure and remaining alive. At the same time it is shown that the market value of the catch is slightly increased. The remedy suggested for the hake is the application of this, for a larger mesh would allow an immensely greater proportion of the young fish to continue their growth, and this in a few years should increase the breeding stock, while meantime the fishery after readjustment should be more profitable. It is possible that on certain grounds there would be a lesser catch of soles, but usually in trawling one fish dominates the plan of each voyage, the profit of which depends upon it.

The above work of the Ministry is applicable to the haddock, cod and many fish, and its scientific staff are to be heartily congratulated upon it and many other lines of applied science. Biologists should know the Ministry's work, for it is the most important ecological work being carried on from Great Britain to-day. They should examine its results, so that their expressed ideas may be considered views which may help to form public opinion, not merely expressions against State action that scientific men often lightly express. Furthermore, it would pay the industry to reprint this little book in a cheap form and place it in the hands of every trawler man, for there is no doubt that education makes for efficiency in this as in all other trades. The fishing industry, it must never be forgotten, is a basal industry, essential to Great Britain as a maritime power.

J. S. G.

Plato's Theory of Knowledge:
the *Theaetetus* and the *Sophist* of Plato translated with a Running Commentary. By Prof. Francis Macdonald Cornford. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xiv+336. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1935.) 15*s*. net.

IT would have been a real treat for philosophers to have a genuine study of Plato's "Theory of Knowledge" by Prof. Cornford. As it stands, however, the title of the book is misleading as it offers no more than an excellent translation of the "Theaetetus" and the "Sophist" with a running commentary. The latter will be found most useful and inspiring by all students of Plato's philosophy, for it aims at discovering what Plato really means and how the arguments of these two dialogues are related to the rest of his work.

Catalogue of the Fossil Cephalopoda in the British Museum (Natural History)

Part 4: The Ammonoidea of the Trias. By Dr. L. F. Spath. Pp. xvi+521+18 plates. (London: British Museum (Natural History), 1934.) n.p.

PARTS 1 to 3 of this Catalogue by Foord and Crick, dealing with the Nautiloids and Palæozoic Ammonoids, were published in 1887, 1891 and 1897 respectively. The new part, although of larger size, includes only about half of the Triassic Ammonoids, namely, the Pronoritida, Xenodiscida, Meekoceratida, and part of the Ceratitida, nearly all occurring in the Lower and Middle Trias. The remaining groups, of Middle and Upper Triassic age, will be dealt with in the succeeding volume. Since the last part was published, our knowledge of Palæozoic Ammonoids has increased considerably, so that the author can now affirm that true Ammonites were already prolific in the Upper Palæozoic, and that the Permian System, contrary to the views of some British geologists, has fully justified its existence.

In the introduction the author gives a critical review of the classifications of Goniatites proposed by previous writers, and expresses in tabular form his own view of the interrelations of the Palæozoic Ammonoids and their connexion with the Lower Triassic Ammonites. In a section on "Chronology and Stratigraphy" he gives a very valuable account of the zonal divisions and correlation of the Triassic deposits, and concludes from his study of the successive faunas that the Triassic period was considerably longer than the whole of the Jurassic. The author maintains that faunas found in different regions which, although showing some differences, have been regarded as contemporary, are really heterochronous. At the same time he admits the existence of life-provinces in the Trias, but gives no criteria by which the differences dependent on age can be distinguished from those due to geographical distribution.

The main part of the Catalogue is devoted to a systematic account of the groups mentioned above, with a discussion of the mutual relationships of the various families and genera. Unlike most writers on the phylogeny of Ammonoids, the author does not accept the evidence of ontogeny, but bases his views on the morphological characters and the stratigraphical succession of forms. His conclusions will be more easily followed if shown in tabular form in the succeeding volume.

An Introduction to Inorganic Chemistry:

for B.Sc. Students of the Indian Universities. By Dr. Satya Prakash. Pp. vii+478. (Allahabad: Kala Press, 1934.) 6 rupees; 10*s*.

DR. PRAKASH'S book has some unusual features. It deals with the elements in the order of the Periodic System, the inert gases coming first, followed by the metals, and the non-metals come last. This has advantages for a student who has completed an elementary course, since his knowledge of the non-metals is refreshed again after he has dealt with the new material. A special feature of the book is the stress laid on Indian conditions and interests, a good deal of statistical data being incorporated and the native processes and names being given. This part will be quite valuable to readers wishing to know something of chemical technology in India. Extensive use is made of tables summarising information given in the text.

The text itself is rather condensed, so that a good deal of ground is covered, and the more elementary parts of the subject are briefly treated. Whilst full equations are given in the text, the summary tables contain unbalanced equations with arrows, such as $NaHSO_3 + Zn + SO_2 \rightarrow Na_2S_2O_4$, which are liable to lead to neglect of the correct equations by weaker students. Dr. Prakash's book is an interesting one of good standard. The English is not always very good, and should be revised in future editions.

Dynamo-Electric Machine in its Historical Development:

Documents and Materials. Collected by D. V. Efremov and M. I. Radovskij. Edited by V. Th. Mitkevitch. (Academy of Sciences of the U.S.S.R.: Transactions of the Institute for the History of Science and Technology, Series 3, Issue 1.) Pp. xviii+560. (Leningrad: Academy of Sciences Press, 1934.) 15 roubles.

THIS volume gives the leading papers and extracts from books, etc., from which we can see the gradual historical development of the modern dynamo. The frontispiece gives a portrait of Faraday and the book begins with his discovery of electromagnetic induction. Practically all the book is in Russian, so it will make a limited appeal to English readers. The table of contents proves that a very wide research has been made through the literature of European countries. It is the first issue of Series III in the *Transactions* of the Russian Institute for the History of Science and Technology. The printing is very clear, but some of the diagrams have not come out very well.

Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L. Wolf. Band 6, Abschnitt 1A: Elektronenstrahlen und ihre Wechselwirkung mit Materie. Von J. Hengstenberg und Karl Wolf. Pp. 236+12. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 24 gold marks.

THE discovery of electron beams is traced back to Pflucker (1859) and the recognition of their nature to Schuster's first determination of the ratio of charge to mass in 1884; but their principal interest arises from the discovery of interference effects, depending on a wave-like character of the electron. This has been demonstrated by the development of Debye-Scherrer rings by scattering (i) in thin films of a solid as in G. P. Thomson's already classical experiments with gold foil and the more recent beautiful photographs of G. I. Finch, and (ii) in vapours, as studied by Mark and Wierl in Ludwigshafen and later in England by de Laszlo. These and cognate topics are reviewed in a monograph which covers 236 pages and includes 182 figures.

Personality and Age*

By Dr. Ll. Wynn Jones

A FEW years ago the readers of many German newspapers were invited by Giese to give an account of the signs by which they noticed that they had become old, and to say at what age these signs first appeared. When these reports were analysed, it appeared that the average age of becoming subjectively old was forty-nine years, but this age of becoming old varied widely with the individual—indeed from age eighteen to eighty-two.

The bodily signs were twice as numerous as the mental. The bodily signs in decreasing order of frequency from 17·4 to 1·2 per cent may briefly be summarised thus: (1) motor (muscles, back, teeth, bones, extremities), (2) nerves (including memory and insomnia), (3) sensory (eye, ear), (4) skin (hair, wrinkles), (5) fatigue, (6) sexual, (7) circulatory (heart, arteries), (8) metabolic (sugar, gout, fat), (9) digestive, (10) kidney, (11) respiratory.

It would, of course, be expected that the layman would be more likely to refer to bodily symptoms than to mental, and it was natural that the more educated should show a higher percentage of mental signs.

The subjects who reported mental signs were divided into three classes:

(1) The negatory type. About 18 per cent of those who reported mental signs opposed the suggestion of being old and either indignantly refused to acknowledge it or perhaps referred to the health or longevity of their stock.

(2) About 38 per cent ascertained that they were old by noting the way they have been treated by the outside world in various situations and the like.

(3) About 44 per cent reported experiences from their own introspections—it might be some intellectual change in reaction such as the emergence of old recollections, or it might be an affective change such as a disinclination for amusements.

It is important that bodily and mental manifestations certainly do not go together and have widely different values for different individuals. Some lay great stress on bodily signs and scarcely any on the mental, while others do just the reverse. It is not, of course, suggested that the percentages reported above would agree with medical diagnosis, as the subjects belonged to a sample of the general population. Moreover, many of the physical symptoms reported had probably a mental origin, for, as Prof. M. Greenwood stated in a recent lecture on "The Temperamental Factor in Industry", "it is becoming realised more and more how easily emotional disturbances may result in bodily ills that can be cured only by dealing with their psychological causes".

Although psychologists have exhibited great interest in the child and the adolescent, yet there remain five or six decades of human life relatively untouched. At least four recent investigations merit our attention. They were initiated by Terman, Thorndike, Walter Miles and Charlotte Bühler respectively. It is significant that each had already made outstanding contributions in child psychology, and each research was furthered by a grant, so that a band of experts were able to collaborate and produce results which would be quite unattainable by a single investigator who had to meet the charges out of his own pocket.

In 1926 there appeared the second volume of Terman's "Genetic Studies of Genius". It is entitled "The Early Mental Traits of Three Hundred Geniuses", and the investigations were carried out by Dr. Catherine M. Cox (now Mrs. Walter R. Miles) under the direction of Terman. It was concluded that youths who achieve eminence have, in general, a heredity above the average and superior advantages in early environment: they are characterised not only by high intellectual traits, but also by persistence of motive and effort, confidence in their abilities, and great strength or force of character.

Thorndike's "Adult Learning" appeared in 1928. His purpose was to study the changes in the amount and changes in the nature of ability to learn from about age fifteen to about age forty-five, and especially from age twenty-five to age forty-five. Some of the conclusions may be briefly summarised:

(1) The differences in rate of learning between old and young are small in comparison with the differences within either group, and when factors other than age are equalised the influence of age approaches zero.

(2) Adults learn much less than they might, partly because they under-estimate their power of learning, and partly because of unpleasant attention and comment. It is disuse and lack of practice and not inner degeneration which is likely to affect learning.

* From the presidential address to Section J (Psychology) of the British Association, delivered at Norwich on September 6.

(3) Ability to learn a systematic logical language, Esperanto, rises from 8 to 16 years and probably to 20: it is then stationary to 25 or later and then drops very, very slowly to 35 and somewhat more rapidly, but still very slowly, to 45 or later.

(4) The gain made in 50 or 100 or 500 hours of study of a modern language by a group of any age from 20 to 40 will be greater than the gain made by a group aged 8 or 10 or 12. The facts are in flat contradiction to the doctrine that childhood is the period for easiest learning to read, write, or understand the hearing of a language.

(5) Learning representing an approximation to sheer modifiability unaided by past learning shows more inferiority in the case of adults than was indicated by the experiments taken as a whole. Actual learning of such things as adults commonly have to learn shows, however, considerably less.

(6) The curve of ability to learn from 22 to 42 is a very slow decline, and this decline is no greater for inferior intelligence than for superior.

Thorndike studied all sorts of learning and in each case analysed the curve of ability to learn in relation to age. Although he realises that a curve of total or average ability may be unattainable, yet he was able to conclude in general that nobody less than forty-five years of age should restrain himself from trying to learn anything because of a belief that he is too old to be able to learn it. "If he fails in learning it, inability due directly to age will very rarely, if ever, be the reason. The reason will commonly be one or more of these: He lacks and always has lacked the capacity to learn that particular thing. His desire to learn it is not strong enough to cause him to give proper attention to it. The ways and means which he adopts are inadequate, and would have been so at any age, to teach him anything. He has habits or ideas or other tendencies which interfere with the new acquisition, and which he is unable or unwilling to alter. In the last case mere age may have some influence."

Thorndike's conclusions are particularly important when we consider schemes for adult education, and it is interesting to see how well his experimental findings agree with Cicero's dicta on age: "But, you argue, the memory grows feebler. I believe it does unless you practise it, or if you are by nature rather dull. . . . What of lawyers, pontiffs, augurs, philosophers when they are old? How much *they* remember! The old retain their wits, provided their earnestness and energy lasts; and this happens not only with men who are illustrious and who have held high office, but also in a life of privacy and repose."

Having reported facts concerning the relation of adult learning to age, we may pass on to consider some of the most important human abilities in their relation to age, and noteworthy in this respect are the Stanford Later Maturity Publications, which have appeared from 1931 onwards under the direction of Prof. Walter R. Miles, and which were aided by a grant from the Carnegie Corporation. A reference to some of these abilities is now necessary.

Sensory and Motor Abilities

The importance of abilities such as reaction speed and co-ordination of movements in the various industries and sports scarcely needs mention. Motor skills are so varied that each has to be studied by itself, and although some evidence for group factors in this field has been obtained, yet in the main it is the specificity of each ability which is striking; and this is not surprising when it is considered that some demand considerable visual acuity, others visual attention, others muscular power, others neuro-muscular speed of reaction, and so forth.

Probably visual acuity is at its maximum in the 'teens. It is probably one of the first physiological functions to show a very slight deterioration with age. About the age of fifty years, on the average, this deterioration may become sufficiently serious to handicap the individual in occupations where visual requirements are exacting. In industry, of course, there are other factors which affect the issue, such as the efforts of an employer to get cheaper, that is, younger, labour, or the effort of the employee himself to acquire a more responsible position. The more striking fact, according to Miles, is the relatively small, although steady, decrement shown throughout the life-span in tests such as reaction speed or rotary motility. "Guessed on the basis of what industry has popularly said of the old and also in terms of the derogatory reports made by old people about themselves, the situation has appeared far harsher than the objective data warrant."

Intellectual Abilities

Under this heading may be considered tests of memory, manipulations of symbols and of space areas, interpretations of meaning in verbal form and all the so-called higher mental functions which figure in tests of intelligence. Here again the deterioration due to age as such is relatively small. The differences between individuals at the older ages are often quite marked, so that other factors are probably at least as weighty as age in accounting for an individual's actual score. Thus Sorenson found that the mental abilities of adults who participate in schemes of adult education are maintained at a high level over a long span of adult years.

Miles also points out that when speed is the stressed element in an intelligence test for adults, then the decrement due to age is greater than it is when power in unlimited time is stressed. The fact that intelligence tests are usually standardised for children also points to the need of further research when dealing with adults.

INTERESTS

Here we turn to one of the Stanford Later Maturity Publications—namely, "Change of Interests with Age", by Prof. Edward K. Strong. It is based on examination of more than two thousand men between the ages of twenty and sixty years representing eight occupations. The following quotation gives the author's point of view: "If 'vocational interest' is defined as 'the occupation an individual likes best now', then the conclusion must be reached that vocational interests are very unstable. There are ample data to prove that boys and girls and also older persons change their 'first choices' very frequently, and in most cases without apparent rhyme or reason. But if 'vocational interest' is defined as 'the sum total of all interests that bear in any way upon an occupational career', then we find surprising stability, certainly among adults, and, as far as we have been able to judge, also among young men of college age and presumably among still younger people."

That is to say, just as we do not probe an individual's intelligence by one test but by as many as we can afford time for, so it should be with interest.

The slight differences found between men of twenty-five and fifty-five years of age seem to indicate that interests are not particularly affected by years of activity in a given occupation, and that therefore interests are responsible for choice of occupation rather than a resultant of it.

Older men are no more catholic in their interests than younger men, but their likes and dislikes are not identical with those of younger men. Thus the older men are not so interested in situations involving physical hazards, or in anything which interferes with established habits. This factor appears to be of great significance for both employer and employee. Many an employer is unsuccessful not so much for lack of abilities, but owing to a disinclination to introduce a change, and the old employee often becomes unemployed not on account of inability, but because he has no desire to change his methods when changes are deemed essential by the management.

I now turn to the extraordinarily interesting book of Prof. Charlotte Bühler, "Der Menschliche Lebenslauf als Psychologisches Problem", which was published in 1933. The course of man's life is studied by the aid of two hundred published biographies of poets, writers, inventors, men of science, statesmen, musicians, painters, theologians, business men, financiers, actors, singers, sportsmen and philosophers. For comparison, fifty life-histories were obtained from the Old People's Homes in Vienna.

Life is regarded from several aspects: as a biological phenomenon, as a series of events and experiences, and from the point of view of work produced. Its normal structure—ascent, culmination and decline—is discussed. It is impossible to do justice to this pioneer study in a brief sketch, and I will only single out what appears to be the importance of age in athletic records. Here, then, Prof. Bühler has at hand the severe tests of the athletic field as substitutes for psychological tests in order to ascertain when various motor abilities are at their maxima in the case of the best athletes. On analysing the best lists for the year 1930 the following were the results:

Individual Sports		Age.	*Group Sports*		Age.
A.	Sprint run	23·5	*A.*	Boxing	21·9
	Long jump	23 5		Wrestling	22·3
	Throwing the javelin	24 2		Football	23·8
B.	Medium run	24 3	*B.*	Jiu-jitsu	26·0
	Hurdles	24 5		Hockey	26·4
	High jump	24·8		Tennis	28·5
	Pole vault	25 4			
	Putting the weight	25·4			
C.	Long run	25·6	*C.*	Polo, Riding, Trotting	up to 50
	Rowing	26 5			
	Throwing the discus	26 9			
	Weight lifting	30·5			
	Throwing the hammer	31·0			

It is characteristic of Group *A* that the activities demand a maximum expenditure of energy per second. Economy of effort plays no part here. In Group *B* there is demanded economy of effort and a proper distribution of it. As for Group *C*, in addition to the greatest economy of effort, enormous demands are made on technique which only comes after long experience.

As two typically British sports are not included in the table—namely, cricket and golf—I have attempted to get corresponding figures for batsmen, bowlers and golfers. Taking the season of 1934, the names of eighty-three batsmen who exceeded a thousand runs in first-class cricket appear. The median age is 30 years (the quartiles being 27 and 33 and the extremes 19 and 47). Then the bowling averages were analysed. The median age is again 30 years (the quartiles being 26 and 34 and the extremes 20 and 50).

Taking the names of the forty golfers who headed the Open Championship list in 1934, the median age is about 35 years (the quartiles being 29 and 39 and the extremes 24 and 45).

Taking a still higher standard, it appears that batsmen who have exceeded three thousand runs in a season show a median age of 34·5 years (the

quartiles being 30 and 39 and the extremes 27 and 44).

In golf, the thirty-seven open champions since 1894 show a median age of 31 years (the quartiles being 28 and 37 and the extremes 23 and 44).

THEORETICAL IMPLICATIONS

A most important development in modern psychology is the search for innate, basic, unitary traits of personality. There is accumulative evidence in favour of the existence of a number of unitary traits or factors, and it has been found convenient to denote them provisionally by letters of the alphabet, analogous to a practice of physics and other sciences. This does not in the least imply that their functional interpretation is necessarily less clear than that of concepts such as introversion and the like. It is true that polysyllabic words have sometimes only to undergo a very cursory censorship, but this practice leads to abuses of the language mechanism which may retard individual cerebral evolution. Besides, the less popular use of letters to denote new concepts is not likely to proceed indefinitely, if only for the fact that the introduction of such a letter is preceded by many thousand hours of laborious work.

Closely connected with the study of traits is the difficult question of the effectiveness of past experiences. Spearman's researches show that retentivity is independent of *g*, and there is evidence that the old tend to deteriorate in tests of immediate memory. How far is the balance redressed when the extent and variety of all their previous experiences as well as their integration is taken into account? It is scarcely necessary to illustrate the dire effects of lack of experience. Thus the brilliant young debater is often pulverised by one who is dull but elderly. My second example is a very intelligent person who has been totally blind from birth. I found that the subject had no idea at all of the size of the sun as it appeared in the sky. The subject imagined that most stars had five points, but that some had six or even eight, and that a rainbow had the shape of a tied bow, and so forth. Manifestly all knowing, even in the case of the gifted, must start from experiencing.

Now that the method of factorial analysis is becoming increasingly effective, not only in the case of cognitive abilities, but also with regard to personality in all its aspects, it becomes necessary to study age as one of the 'primordial potencies' more systematically, not only during childhood and adolescence, but also throughout the life-span. This will determine the relative importance of the various traits at different stages of life, and in turn will lead to a fuller psychological interpretation of the unitary traits themselves.

Recent Advances in Seismology*

By Dr. F. J. W. Whipple, Kew Observatory, Richmond, Surrey

SEISMOLOGY, the science of earthquakes, is primarily concerned with such questions as where, how and why earthquakes occur, but it is also concerned with the question how the waves generated by earthquakes travel through the earth, and with the question what information as to the constitution of the earth can be deduced from the behaviour of the waves. Living in a country which is seldom troubled by earthquakes, but a country in which the waves from distant earthquakes can be studied, we have a more direct interest in questions of the latter types. This interest has been fostered by the British Association, which has facilitated the discussion and collection of the records from observatories in all parts of the world. This is an enterprise of which we may well be proud.

John Milne, who was a great pioneer, organised the collection of observations. He used to publish lists of the readings of the seismograms at as many observatories as possible. On the death of Milne, Prof. H. H. Turner, who was already chairman of the B.A. committee, accepted responsibility for the work, which he transferred to the University Observatory, Oxford, and soon began the publication of the observations in a more convenient form, dealing with each earthquake separately. This arrangement was continued when Turner became president of the Seismological Section of the International Union for Geodesy and Geophysics. The collections of observations are now known as the International Seismological Summary. As the number and efficiency of seismological stations has increased, so the I.S.S. has grown. The Summary for 1930 is a substantial volume of 426 pages. Since Turner's death in

* Paper read before Section A of the British Association at Norwich on September 9, opening a discussion on recent advances in seismology.

1930, the work has been carried on most loyally and efficiently by Mr. Hughes and Miss Bellamy. Seismologists are under a great debt of gratitude to them, and to Prof. H. H. Plaskett who has given facilities for the continuation of the work.

The I.S.S. provides a wealth of material for research. One of the objects which Turner had at heart was the preparation of more reliable tables of the travel times of earthquakes. This task was eventually undertaken by Dr. H. Jeffreys, whose revised tables for the times of *P* and *S* waves were published in 1932. Jeffreys regarded this work as a preliminary to a closer examination of the material, and with the help of Mr. K. E. Bullen he discussed the records of 61 earthquakes. For each the epicentre was redetermined and a close examination of the material of the I.S.S. was made to discover the reflected waves of different types.

The results of this heavy investigation were presented by Jeffreys at the Lisbon meeting of the I.S.A. two years ago, and have now been published. It was not to be expected that there would be anything very exciting in the results. Perhaps that is the strongest reason for admiring the enterprise of Jeffreys and Bullen. The most striking development is the confirmation of an irregularity in the run of the times of transmission of the waves of compression and distortion. This irregularity, which occurs at ranges of about 20°, had previously been studied by Miss Lehmann of Copenhagen and probably signifies that there is a discontinuity in the nature of the rocks at a depth of about 400 km.

An interesting development was the calculation by an indirect method of the time required for shearing waves to travel to the core and back. An *S* wave which reaches the core is resolved into a reflected wave, known as *ScS*, and a transmitted *K* wave. When a *K* wave reaches the boundary of the core again, some of the energy passes out as an *S* wave and some is reflected to pass out further on. Thus *SKS* and *SKKS* are produced. It is clear that the time of transmission of the *SKS* is the mean between the times for the *ScS* and *SKKS* waves. Thus the time for *ScS* waves where they are not readily observed could be calculated. It should be mentioned that Dr. Jeffreys has recently revised this *ScS* table, using records for deep focus earthquakes.

The Jeffreys and Bullen tables are now being used as the standard of reference of the I.S.S. so that they will be the starting point for the investigations of such questions as the possible departure of the earth from spherical symmetry.

The most spectacular of recent advances in seismology is in our knowledge of earthquakes with deep foci. Turner was led to the discovery of such earthquakes by finding that the ordinary tables of transmission times, which were reasonably satisfactory for ordinary earthquakes, were not applicable in certain cases. He was led to attribute the abnormality to the depth of foci, which might in some cases be so great as 9 per cent of the earth's radius, or 500 km. Similar conclusions were reached by Wadati in Japan, and the theory was confirmed by the close analysis of world-wide records by Scrase and Stechschulte.

That the great majority of the earthquakes were to be found round the Pacific was noticed by

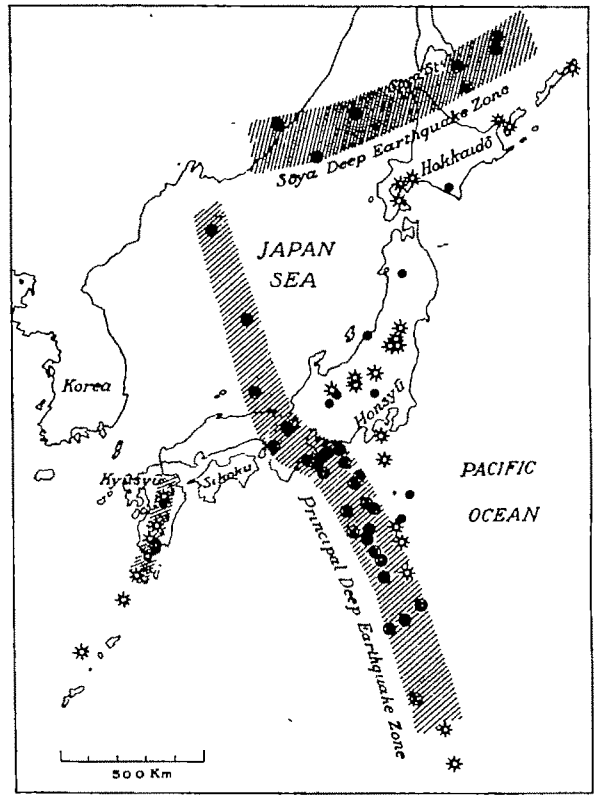

FIG. 1. Deep-focus earthquake zones and volcanoes.
● Deep earthquakes which occurred during 1927–33; * Volcanoes which have been in eruption since 1867. From *Geophysical Magazine* (Tokyo), 8, No. 2; 1934.

Turner. Japanese seismologists have mapped the foci near their own country with striking results. There is a remarkably orderly arrangement. Not only are the foci to be found on two belts meeting at right angles on the continental side of the sea of Japan, but also the depths are systematically arranged, the greatest on the outside of the angle formed by the belts.

In Fig. 1, which is due to H. Honda, the positions of the zones in which deep-focus earthquakes occur are shown, together with the positions of such volcanoes as have been in eruption since 1867. Fig. 2 is reproduced from a paper by K. Wadati. In this diagram the two principal zones

of deep focus earthquakes are joined by lines which serve to emphasise the distribution of

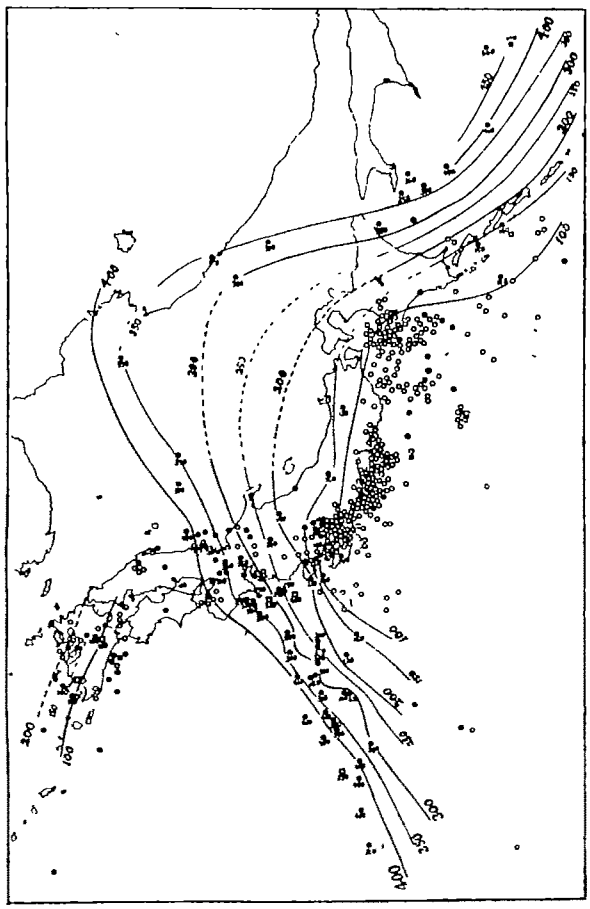

FIG. 2. Lines of equal focal depth for deep-focus earthquakes. ● Deep-focus earthquakes; ○ shallow-focus earthquakes; □, foci not accurately determined. From *Geophysical Magazine* (Tokyo), 8, Nos. 3, 4; 1935.

depth. The innermost of these lines indicates the position of foci with depths of 100 km., the outermost of the main series of lines indicates a depth of 400 km. The way in which the foci of ordinary earthquakes cluster on the east of Japan is also illustrated in this diagram.

The directions of the impulsive movements in deep-focus earthquakes with their foci near to the region where the main belt crosses Japan have been studied by Honda. He finds that at places to the north-east of the belt the ground moves downwards and towards the belt. At places to the south-west the movement is upwards and away from the belt. Thus it appears likely that huge faults extending to a depth of about 400 km. or more can exist in the earth's crust and that deep foci are on such faults. Volcanoes, live and extinct, are found above the line where the fault is at a depth of 100 km., whilst ordinary earthquakes with shallow focus occur near where the fault approaches the surface.

It has been suggested that the high frequency of earthquakes round the Pacific is due to the fact that the crust of the earth below an ocean cools more rapidly than the crust over the continents, where the radioactivity of the granite provides a source of heat.

In various studies of the times of transmission of seismic waves it has been found that the thickness of the continental granite is about 15 km. Thus the occurrence of deep-focus earthquakes implies that the strains in the crust lead to fractures at depths of the order twenty times the probable thickness of the granite. Can it be that the influence of a mere skin extends to such a depth? These foci are also far below the level at which isostatic compensation has been supposed hitherto to be operative. It is clear that they must be taken into account in all speculations as to the history of the globe.

Obituary

Prof. Henry Fairfield Osborn, For.Mem.R.S.

PROF. HENRY FAIRFIELD OSBORN, who died at his home, Castle Rock, Garrison-on-Hudson, N.Y., on November 6, 1935, was one of the foremost palæontologists of the United States, and made great contributions to our knowledge of fossil mammals and reptiles. He was born on August 8, 1857, at Fairfield, Connecticut, and began his scientific education in 1873 at Princeton College (afterwards University), where he was influenced especially by President James McCosh, the psychologist, and Prof. Arnold Guyot, the geologist. After graduating in 1877, he studied human anatomy and histology under Prof. William H. Welch, in New York; and in 1879–80 he followed brief courses in embryology under F. M. Balfour at Cambridge, and in comparative anatomy under Huxley in London. He then returned to Princeton with a biological fellowship, and in 1881 he was appointed assistant professor of natural science. In 1883 he was promoted to the professorship of comparative anatomy at Princeton, where he remained until 1891.

While Osborn was a student at Princeton, great interest was being aroused by the discoveries of numerous strange extinct mammals and reptiles by Cope and Marsh in the rocks of the western United States. At the end of his course, therefore, in 1877, he and his fellow-students, W. B. Scott and F. Speir, decided to undertake a summer trip to Wyoming in search of similar fossils, and they brought back a

small collection of early Tertiary mammalian remains, on which they published a report. In the following year they went again to Wyoming and Colorado to continue their collecting, and in subsequent years one or other of them paid repeated visits to the west for similar field work. Princeton thus began to take a share in making known the remarkable extinct vertebrates which awaited discovery in the western country then becoming more readily accessible.

These researches attracted the notice of the trustees of the American Museum of Natural History and the professors of Columbia College (afterwards University) in New York. The Museum wished to extend its scope and make a representative collection of fossil vertebrates, while Columbia decided to add biology to the subjects to be taught. In 1891, Osborn was therefore invited to become curator of the Department of Vertebrate Palæontology in the American Museum, and at the same time the first professor of biology (afterwards zoology) in Columbia University. He accepted both these appointments, and held them with brilliant success until 1910, when he had thoroughly organised them and had trained a staff to continue his work. Having ample private means, he then retired to devote himself entirely to palæontological research and to the administration of the Museum. Meanwhile, he was nominated research professor of zoology in the University, and he continued to be assistant to the president of the Museum. In 1901 he was elected a trustee and vice-president of the Museum, and eventually from 1908 until 1933 he served as president. At the same time, from 1900 onwards, Osborn was vertebrate palæontologist to the U.S. Geological Survey, and for four years (1900–4) he also held the same office in the Geological Survey of Canada. In 1906 he was nominated secretary of the Smithsonian Institution, Washington, but he decided to remain at New York.

The earlier collectors of fossils in the west had been handicapped by the frequent presence of hostile Indians, who had made detailed geological surveying impossible. When Osborn began his work at the American Museum, conditions were improving, and he took advantage of this circumstance to arrange that collectors in future should devote as much time as necessary to determining the succession of the rocks in which the various fossils occurred. Year after year he sent out his trained assistants to collect in this way, and he frequently accompanied them with help and encouragement. He and his wealthy friends provided adequate funds for the explorations, and thus was accumulated in the American Museum a unique series of fossil vertebrates of which the relative ages were definitely known. Most of these fossils were mammalian remains from the Tertiary formations, and as soon as the most important of them had been examined and described by himself and his colleagues, Osborn greatly facilitated research by publishing his "Correlation between Tertiary Mammal Horizons of Europe and America" (1900). The American Museum then began to take an active interest in the discovery of fossil vertebrates in other parts of the world. In 1898 it had already shared in the Princeton University's third expedition to Patagonia. In 1906–7, Osborn himself accompanied a party in the Fayum, Egypt. In 1922 he visited central Asia, where American Museum expeditions under Dr. Roy Chapman Andrews had already made important collections of new fossil vertebrates. In 1923 another expedition under Dr. Barnum Brown collected fossil mammals in India. Osborn had, indeed, wisely decided that our knowledge of extinct faunas could best be advanced by direct comparison of the fossils of one part of the world with those of another, and that American palæontology must not be isolated.

While occupied with the planning and direction of the collecting expeditions and the preparation of the fossils in the Museum, Osborn and his staff published a long series of valuable papers on various parts of the collection and on the rocks in which they were found. He also contemplated the publication of several exhaustive memoirs on groups which were specially well represented in America, but he was only able to complete one on the Equidæ or horses (1918) and one on the Titanotheres (1929). Others on the Elephants and the Sauropodous Dinosaurs were left in a forward state of preparation. The published memoirs are noteworthy for their beautiful illustrations and their wealth of valuable facts; but their composite authorship and their peculiar style of composition make them sometimes unsatisfactory for reference.

Osborn also found time to write several books which have contributed to the advance of vertebrate palæontology or spread an interest in the subject. His early work "From the Greeks to Darwin" (1894) has often been reprinted, and it was eventually issued in a revised edition. His "Evolution of Mammalian Molar Teeth" (1907) and "The Age of Mammals" (1910) are technical works of reference. His "Men of the Old Stone Age" (1915) and "Man rises to Parnassus" (1927) are popular works which have had a very wide circulation. His "Origin and Evolution of Life" (1916–17) is semi-popular. His volumes on "Impressions of Great Naturalists" (1924) and on "Cope: Master Naturalist" (1931) contain many interesting personal reminiscences.

Osborn's genial personality and calm sound judgement led to his being appealed to for help in many undertakings beyond his chosen sphere. He took a prominent part, for example, in the foundation of the New York Zoological Society and the planning of its Zoological Park, and he was president of the organisation from 1909 until 1923. He was also well known and much esteemed in England, where he received many tokens of appreciation. He was an honorary D.Sc. of Oxford and Sc.D. of Cambridge. He was a foreign member of the Royal Society, and of the Linnean, Geological and Zoological Societies of London; and an honorary member of the Royal Society of Edinburgh and the Royal Irish Academy. He received the Darwin Medal from the Royal Society in 1918, and the Wollaston Medal from the Geological Society of London in 1926. The death of an old friend and colleague is indeed widely mourned.

A. S. W.

News and Views

Henry Fairfield Osborn and the American Museum

PROF. H. FAIRFIELD OSBORN, an obituary of whom appears on p. 784 of this issue of NATURE, was a figure in certain respects unique in American science. In virtue of his great possessions, he belonged to a class more frequently encountered in business than in academic circles in the United States, and his personal connexions played no small part in aiding him to raise the American Museum of Natural History, of which he was honorary life president at the time of his death, to the commanding position in the scientific world which it now holds. Under his controlling influence, its scientific achievement, equally remarkable in range and variety, was no less notable than its growth and its efficiency in material equipment; while graded series of publications, ranging from popular expositions to detailed monographic studies, and from ephemeral announcements of recent discovery to the considered conclusions of prolonged research, became a regular and highly valued feature in the organisation of the Museum, placing the latest developments of its work at the disposal of laymen and the scientific world alike. One of the greatest achievements of the Museum under his régime, and certainly the most spectacular, was the organisation of the great scientific expedition to Mongolia. It was unfortunate that after some years of work, which had produced results of the greatest importance to science in palæontology, geology, archæology, and the other branches of research for which provision had been made, clash with Chinese authority should have brought the expedition to a close at a moment when Osborn was about to build up an organisation in China, which promised to emulate within its limits the achievement of the parent institution in New York.

Chromosome Behaviour and Protein Pattern

IT is announced in the *Oxford University Gazette* of November 6, that the curators of the University Chest have been authorised by Congregation to receive from the Rockefeller Foundation a grant of £500 a year for five years for the purposes of research in the application of mathematical analysis to biological problems, to be conducted by Dr. Dorothy Wrinch. Apparently this grant is to enable Dr. Wrinch to continue and develop her researches into relationships between chromosomes and protein aggregates which have been the subject of several notable contributions, three of which appeared in NATURE during the past year (**134**, 978; **135**, 788; **136**, 68). She graduated at Cambridge in 1916 and was a wrangler in the Mathematical Tripos. Since then she has had a distinguished career in teaching and research, having been successively lecturer in the Department of Pure Mathematics, University College, London; Yarrow scientific research fellow and Bertha Ayrton fellow of Girton College, Cambridge; and lecturer in mathematics and Susette Taylor fellow of Lady Margaret Hall, Oxford. While holding the two last-named fellowships in 1931–34 she spent part of the time at the Universities of Vienna, Paris, and Prague. So long ago as 1921, Dr. Wrinch contributed a paper to NATURE, with Dr. Harold Jeffreys, on "The Relation of Geometry to Einstein's Theory of Gravitation"; and among many other subjects of wide interest with which she has dealt in papers to scientific societies are the theory of probability, principles of scientific inquiry, relations of science and philosophy, and boundary problems of mathematical physics. Her recent work on the structure and behaviour of chromosomes in relation to protein aggregates is a new field of inquiry from which further results of high importance may be confidently anticipated.

The King of the Belgians

AT the general meeting of the Linnean Society of London held on November 7, His Majesty The King of the Belgians was unanimously elected an honorary member of the Society. His Majesty is known to take a keen interest in natural history. When Crown Prince, he made a voyage to the Dutch East Indies in 1928–29, one result of which was a very important collection of specimens for the Royal Museum of Natural History in Brussels. He has also taken an active interest in the preservation of the fauna of Africa by the establishment of Nature reserves. The great Parc National Albert in the Belgian Congo, the area of which has recently been greatly extended, owes much to His Majesty's patronage and influence, and constitutes one of the most important experiments ever made in the conservation of wild Nature.

American Stratosphere Balloon *Explorer II*

A NOTABLE achievement falls to the credit of Capts. A. W. Stevens and Earl A. Anderson of the U.S. Army Air Corps, who, according to the reports in the daily Press, have successfully piloted their stratosphere balloon up to the record height of 74,000 feet. The previous record was held by the ill-fated Russian balloon *Osoaviakhim* which probably reached a height of 72,000 feet on January 30, 1934. After the first set-back of last July, when the top of *Explorer II* burst and released 375,000 cubic feet of helium, another occurred on Monday, November 11, when a 20-ft. rent in the envelope, produced during its inflation, had to be repaired at the last moment. The ascent was made at 7 a.m. from a point eleven miles west of Rapid City, and a safe landing was made in the evening at White Lake, South Dakota. Capt. Stevens reported by wireless that at his maximum height the external temperature was −55° C., the cosmic ray intensity 150 times that at the earth's surface, and that the sky had become a jet black awning.

Imperial Airways New Programme

SPEAKING at the annual meeting of Imperial Airways, Sir Eric Geddes outlined the possibilities of, at least experimental, passenger- and mail-carrying operations across the North Atlantic next summer. A 'Mayo' composite aircraft in which a large seaplane, with good 'get off' characteristics, carries a smaller long-distance machine upon its back, releasing it at a suitable height, and also a large flying boat of more normal design are under construction, both of them having sufficient range to fly the Atlantic with adequate reserve. The westward journey will probably be London, Azores, Bermuda, New York, the latter stage being operated in conjunction with Pan-American Airways. Eastwards the direct line New York, Port Botwood (Newfoundland), Cork or Bantry Bay (Ireland), London has been surveyed, although the intermediate stations in Canada and Ireland are not yet definitely settled. The longer route outwards is necessary as stops are needed for refuelling. The prevailing west to east winds make it impossible to fly the more direct route, without landing between Ireland and Newfoundland, with sufficient fuel and still to have an economic load-carrying capacity. On the return journey, this following wind not only reduces the air mileage but also increases the relative speed.

THE distance from Newfoundland to Ireland is about 1,900 miles, and a flying boat with only a little more nominal air endurance will actually have a considerable reserve, owing to the almost constant following wind. There are also envisaged extensions to this route across Canada to Vancouver, Khartoum to Nigeria from the England–South Africa route, and Hong-Kong to Penang from the main Australian route. Sir Eric stressed the fact that there is a great difference between speeds technically possible and those commercially practicable, and stated that there is a greater demand for a reduction in fares than for an increase in speed. Nevertheless, the new aircraft on order will give substantial increases in speed next summer, subject to ground organisation being provided of a suitable standard. For example, it is expected to reach Australia in seven days, South Africa in four days and India in three, with normal schedule working.

Rebuilding Birkbeck College

IN the murky atmosphere of a Strand tavern on a dreary December evening more than a century ago, the germ of a great ideal first struggled into existence. George Birkbeck, who presided on the occasion, was a man of vision, but it is to be doubted whether even he had more than a glimmering of what the future held for his latest child. Since that night—the gathering of a couple of thousand working men did not disperse until 3 a.m.—Birkbeck College has become an integral part of the body scientific. The appeal launched at the Mansion House on November 7 for funds for rebuilding Birkbeck College is of the highest importance not only to the College alumni but also to scientific workers throughout Great Britain. The Lord Mayor (Sir Stephen Killick), an old student of the College, presided, supported by the Duke of York, president of the College, accompanied by the Duchess, the Archbishop of Canterbury, the Vice-Chancellor of the University of London (Dr. Eason) and the chairman of the Governing Body (Mr. W. L. Hichens). Owing to the general election, Mr. Ramsay MacDonald, another old student, was unable to attend, but wrote a letter strongly supporting the appeal.

THE Lord Mayor said the present buildings of Birkbeck College are inadequate, and that the University of London has offered a position for a new building on the Bloomsbury site. Generous grants towards the rebuilding fund have been offered by the University, the London County Council and the City Corporation. About half of the £250,000 required has been promised. The Vice-Chancellor contributed interesting information about the work of the College, referring particularly to its 200 post-graduate research workers and to Prof. P. M. S. Blackett's research work on cosmic rays, to which £1,150 has been contributed from the Mond Fund of the Royal Society. As the Archbishop of Canterbury pointed out, the movement to bring the worker to the university rather than the reverse process is an ideal to which the energies of all should be directed. The academic record of Birkbeck staff is high, and an increasing volume of significant research is being prosecuted under their direction; research which, in the words of Mr. Ramsay MacDonald, is fraught with possibilities of the highest importance to our great industrial centres. The appeal merits a speedy and generous response. Let him who hath give; and let him who hath not, proclaim the worthiness of a common cause.

School and Museum in London Education

IN order to take fuller advantage of the exceptional opportunities afforded by the museums of London of adding background to the curriculum of the schools, the London County Council decided early in the current year to add to the staff of its inspectorate an officer who would serve as a liaison between museum and school. School visits to the museums have long figured in the time-table; but it had become evident that some organisation of objective was necessary to secure the full return for the time which these visits demand. The resolution of the Council has been given effect by the appointment of Dr. Louis W. G. Malcolm to the post; and arrangements have been made already under his supervision for an extension of the system of school visits and lectures in the museums to cover a wide field of subjects of topical and educational interest. In the Imperial Institute, for example, geographical films are being shown and lectures given on the Mediterranean, Malta, Gibraltar, Cyprus and Suez, and these will be followed by illustrations of the industries and occupations of the more distant parts of the Empire. In the London Museum, the history of London from prehistoric to Stuart times is to be demonstrated. Among other

museums at present participating in the scheme are the Victoria and Albert, Horniman and Geffrye Museums. Dr. Malcolm, who was a research scholar in anthropology of Christ's College, Cambridge, and obtained his Ph.D. degree for a thesis on the history and development of medical museums, not only has a wide and varied experience of museum work, but he has also devoted much attention to the practical development of the museum collection as a part of the machinery of education. His work will be supported by a strong and informed committee of the County Council.

Research on Carcinogenic Compounds

THE thirty-first Bedson Lecture was delivered by Prof. J. W. Cook, of the Cancer Hospital, London, to the Bedson Club at Armstrong College, Newcastle-on-Tyne, on November 8. Prof. Cook took as his subject "The Synthesis and Biological Effects of Carcinogenic Hydrocarbons", and said it has long been known that certain forms of skin cancer are due to occupational causes, such cases being prevalent among workers in the coal-tar and allied industries, in the shale oil industry and among mule spinners in cotton mills. This is due to the action of a common constituent of coal tar, and shale and lubricating oil, the isolation and identification of which was successfully accomplished about three years ago in the research laboratories of the Cancer Hospital, London. A very valuable guide in the difficult task of separating this substance from the other constituents of the mixtures was provided by the fact that these tars and oils having carcinogenic properties are all strongly fluorescent. An investigation of the nature of this fluorescence spectrum directed attention to the benzanthracene group of hydrocarbons. Many of these have been prepared artificially in the laboratory, and some have been shown capable of producing cancer in mice. The cancer-producing constituent of coal tar, etc., benzpyrene, belongs to this group. More recently, it has been found possible to bring about the artificial conversion of substances normally present in the human body, namely, cholic and deoxycholic acids, into a hydrocarbon of the benzanthracene type, methylcholanthrene, and this was found to be more powerfully cancer-producing than any other substance yet investigated. The chemical changes by which it was obtained are of the type which are well known to occur in the body, and it may be that cancer in man is due to some such substance as a bile acid undergoing decomposition in an abnormal manner, with conversion into cancer-producing substances.

Chemistry in the Universities and Schools

"THE Teaching of Chemistry" was the subject chosen by Prof. Arthur Smithells, director of the Salters' Institute of Industrial Chemistry, for his Harrison Memorial Lecture to the Pharmaceutical Society on November 12. The chief difficulty of the university professor of chemistry lies in dealing with a subject in which the advance has been of unparalleled rapidity and, most recently, in changes on the theoretical side which have not only led to the acquisition of tracts of new knowledge, but also have affected science at its very base. Prof. Smithells believes that these advances have placed a great burden on the student, and especially on his memory. The reduction and emendation of the curriculum would result in a gain far exceeding in importance any possible loss in its range. Passing to the teaching of chemistry to those whose dominant interest is its application to some particular calling, reference was made to students of medicine as an example. Prof. Smithells himself had placed such students in a course apart, where he had striven, without any intellectual sacrifice, to invest the teaching throughout with facts and illustrations connected with the medical calling. The teaching of chemistry in schools, after a period of rapid growth, became a mere small-scale replica in contents and form of the early chemical course of a university. This teaching led to the revolt, headed by Prof. H. E. Armstrong, who from then to the present day has stood as the great campaigner against all that has seemed unsound in chemical education, wherever it has appeared, but, above all, in its earlier stages. The influence exerted inevitably by the university teacher has been far beyond what is warranted. Relief of the crowded curriculum has been sought by relegating to the schools so much higher work in science that there is a real danger existing of just that kind of over-balance of one kind of subject, as was the case with classics when science first sought admission to the curriculum.

Weights and Balances in Ancient Egypt

AT the Friday evening discourse at the Royal Institution on November 8, Prof. S. R. K. Glanville discussed "Weights and Balances in Ancient Egypt". The actual weights recovered from Ancient Egypt divide into eight main standards, derived from a much larger number in very early times. What we have go back to prehistoric times and show a gradual fusion of the standards, a process which is completed by the seventh century B.C. The balance may be traced from the Old Kingdom, with a possible example of a balance beam from pre-dynastic times. The New Kingdom balance, which lasted at any rate until the Ptolemaic period, was very efficient, and shows a greater accuracy in its design than the small Roman balance which succeeded it. There is evidence of a standard of exchange in ordinary transactions from the Old Kingdom, though whether this standard was a piece of metal, which could be passed between buyer and seller, is questionable at this period. The explanation of the lack of evidence for such mediums of exchange is probably in the nature of the organisation of the country in earliest times as a huge estate owned by the king, and later as a number of big estates controlled by governors and priesthoods, a condition which to some extent exists to-day. These estates being largely self-sufficing, it was possible to conduct their economic affairs without resort to anything approaching currency. There is, however, evidence of the use in the Middle Kingdom of copper pieces, and of a much more frequent use in the New

Kingdom of silver pieces which gave way to copper as the State grew poorer, the whole standard being backed by gold. It is difficult to decide how far the balance was used for general purposes, as its representation on tomb paintings is almost confined to the weighing of gold, silver and precious stones, either domestically for distribution to the metal workers on private or public estates, or as a registration of income or taxes from within the State or of 'tribute' or prizes of war from abroad.

Sewage Purification

MR. JOHN D. WATSON, in his presidential address delivered on November 5 to the Institution of Civil Engineers, dealt with the phases of public works which have engaged his attention for more than half a century, and showed how the development of sanitation and improved water-supplies has brought about a very considerable reduction in the death-rate. He spoke of the Iddesleigh Commission, the reports of which showed that the disposal of sewage into an adequate volume of clean water—either salt or fresh—is sound and proper, not only on the grounds of efficiency and economy, but also on strictly scientific principles. As a matter of principle, purification by land-irrigation is sound and still fairly popular. Percolating filters are now popular, and while this method of purification has a direct relationship to the contact-bed method, it produces a more consistently uniform effluent, is more generally reliable and the operating costs are less. Although almost unknown twenty years ago, bio-aeration or activated sludge is now established beyond question as one of the most useful methods of sewage purification. It has proved itself to be scientifically sound, and, when the plant is well designed, it is economical and freer from nuisance than any method yet discovered. Having stated the most desirable lines for future development and discussed several noteworthy schemes, Mr. Watson emphasised the extent of loss resulting from lack of co-operation, and concluded his address by pointing out that, while the nation owes a great deal to the Ministry of Health, there is still much to be done before the goal is reached when there will be no river-pollution. In his opinion, a central authority is necessary, and this should be the Ministry of Health rather than the *ad hoc* body suggested by the Royal Commission, provided that power is given to set up a research department wide enough to include the excellent work which has been done in recent years by the Water Pollution Research Board.

South African Association for the Advancement of Science

THE South African Association for the Advancement of Science held its annual meeting at Paarl on July 1–6. On July 1, Prof. M. M. Rindl, professor of chemistry in Grey University College, Bloemfontein, president of the Association, delivered an address entitled "A Plea for the Establishment of a National Research Council and for the Limitation of a National Research Policy in South Africa". Replying to criticisms of the Association and its policy, Prof. Rindl said that provision of funds for fostering research in the form of fellowships, scholarships and research grants in South Africa is not ungenerous. Much of this is directly attributable to the persistent agitation of the Association. In its early days, the Association and the Royal Society of South Africa were the only bodies providing research grants from their own funds. Furthermore, the annual award of the South Africa Medal and Grant to a prominent research worker in South Africa has done much to stimulate competition among investigators. As a result of the Association's action, a national committee of intellectual co-operation has been appointed, and it is hoped that the outcome will be the establishment of a National Research Council, and the inauguration of a national research policy on lines similar to those adopted in Great Britain, the Dominions and in many industrialised countries oversea. Another activity of the Association has been to appoint a committee to collect authentic data of the early history of scientific endeavour and industrial achievement in South Africa. With this end in view, the committee is approaching pioneers of science and industry to place on record their reminiscences and the history of the development in the industries which they founded, or with which they have been associated.

AT the conclusion of his address, Prof. Rindl presented the South Africa Medal and Grant to Dr. Edwin Percy Phillips, and the British Association Medal and Grant to Miss Margaret Orford. His Excellency the Earl of Clarendon, Governor-General of the Union of South Africa, has graciously accepted the invitation of the Council to become the president of the Association for the year 1935–36. This will be the thirty-fourth annual session and will be held at Johannesburg. For this year the Association is departing from its normal procedure of meeting in July, and the Johannesburg session will be held on October 5–10. Members attending the meeting thus will have opportunity of visiting the Empire Exhibition, which is being staged for several months in Johannesburg.

Mellon Institute of Industrial Research

IN accepting the Chemical Industry Medal for 1935, at the meeting of the American Section of the Society of Chemical Industry, at the Chemists' Club, New York, on November 8, Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa., described some of the scientific investigations at the Institute. The Mellon Institute is an industrial experiment station, a training school for industrial scientific workers, a centre for research in pure, as well as applied, chemistry, and a clearing-house on specific scientific information for the public. Dr. Weidlein said that the Mellon Institute has shown about 3,600 American companies, either as individuals or as members of industrial associations, that scientific research, properly carried out, is profitable to them. Most of the problems accepted for study during 1911–35 have been solved satisfactorily. The Institute has also

been active in stimulating research in other laboratories and in collaborating with other research establishments, both in the United States and abroad. It is best known, however, by the commercial processes that it has evolved (582 U.S. patents) and by its additions to the literature of chemistry and allied sciences (18 books, 122 bulletins, and 1,727 papers). During the past twenty-four years, the Institute has received more than 10,000,000 dollars from industrial fellowship donors to defray the cost of scientific investigations conducted for these companies and associations. Dr. Weidlein referred to no less than ten new industries that have come from these researches. In conclusion, he said that they hope to occupy the Institute's new building early next year.

Relief of Animal Suffering

THE ninth Stephen Paget Memorial Lecture of the Research Defence Society was delivered last June by Sir Frederick Hobday, the Principal of the Royal Veterinary College, who chose as his subject "The Relief of Animal Suffering" (*The Fight against Disease*, **23**, No. 3). The attacks of anti-vivisectionists are directed not only against research work for the relief of human suffering, but also against research on diseases of animals, so that the subject of Sir Frederick's address was opportune. After some preliminary remarks on the statistics of the animal population of Great Britain and the diseases that affect them and on the training of the veterinary surgeon, he first mentioned the electric killer. The animal receives a shock of 70 volts by touching it on the head for a few seconds with the instrument connected to a source of electric supply, and it is claimed that the animal is thus rendered unconscious for 2½ minutes, during which time the blood may be withdrawn. Remarks were then made on articles accidentally swallowed by animals and their treatment, and finally on glanders, mange and other diseases affecting animals, and their prevention and treatment, illustrating everyday cases brought to the veterinary surgeon. At the annual general meeting of the Society, which followed the lecture, the honorary treasurer, Sir Leonard Rogers, pointed out that the expenditure of the Society somewhat exceeds its income, and additional subscriptions and donations would, therefore, be welcome.

Artificial Drying of Grass and Other Fodder

IN the agricultural world, much has been heard recently of the high nutritive value of grass and fodder crops when cut at a very early stage, and also of the possibility of preserving these special qualities by artificial drying. The Committee appointed by the Agricultural Research Council to investigate these questions has now issued its report, "The Preservation of Grass and other Fodder Crops" (London: H.M. Stationery Office. 1*s*. net), which provides an up-to-date authoritative account of the whole subject. After surveying the methods at present available for hay-making, ensilage, etc., the committee shows that the artificial drying of grass in the usual hay stage does not promise to be a paying proposition. Drying grass cut young at frequent intervals throughout the season, however, has a good prospect of economic success, particularly in districts of moderate or high rainfall on land in good condition. The report then gives a full account of the methods for cutting and collecting young grass, the physical principles of drying grass, the special practical requirements of a farm drier, the cost of drying and the methods of processing and storage. Descriptions are also given of driers now on the market or those shortly to appear there, those suitable for farm as apart from large-scale factory use receiving special attention. The report concludes with a bibliography for those desirous of still further information.

Safety in Mines Research

WE have received from the Mines Department the thirteenth annual report of the Safety in Mines Research Board for the year 1934. This contains a large amount of interesting and valuable matter. The report proper, after a general introduction, deals with safety instructions, and then there is an important section (Part 3) on the progress of safety researches, dealing with coal-dust explosions, firedamp explosions, spontaneous combustion of coal, mining explosives, falls of ground, haulage, wire ropes and mine ventilation, while the next part deals briefly with various health researches reported by the Health Advisory Committee of the Mines Department. The report is followed by a number of appendixes which are of great importance, and cover the work of the various local committees; it is interesting to see that the value of protective equipment is becoming more widely recognised by the miners.

The Colonial Institute of Holland

WE have received the annual report of the Royal Colonial Institute, Amsterdam (Koninklijke Vereeniging Koloniaal Instituut, Amsterdam), which has now been in existence for twenty-four years. It gives an account of the activities of the Institute, its funds, the museum, and scientific expeditions, and of the affiliated institutes in the Dutch East Indies. A list of the staff and of their publications is given, together with a summary of the research work carried out. The last-named includes investigations on rhinoscleroma, dengue and food-poisoning, and on the mosquito fauna of Holland.

Meteor Observations in U.S.S.R.

WITH the object of studying the acceleration of the velocity of a meteor, the Moscow branch of the U.S.S.R. Astro-Geodetical Society has installed a camera of focal ratio *f*2 behind a two-bladed fan, which interrupts the exposure on a star field nine times per second, at Koutchino, twenty kilometres east of Moscow. Prints of two photographs—one of a meteor and another of a meteor spectrum—together with a note upon meteor observations, have reached us from Moscow. From a typical example of observations collected (to be described in the *Monthly Notices of the Royal Astronomical Society* by

MM. Fedynski and Stanjukowitsch) it appears that the velocity decreases by 37 per cent as the meteor falls from 90 km. to 55 km. in height. The same group of observers conducts observations of meteor spectra with a prismatic camera; forty-seven lines were recognised by M. Fedynski in a meteor of stellar magnitude − 3, of which the strongest were those of ionised calcium. A third exposure, made in a camera distant 1·5 km., enables the observers to compute the height of the meteor at any point on its illuminated path.

A Naked-Eye Sunspot

A GROUP of sunspots, large enough to be seen with the naked eye, has been in transit across the sun's disk (Nov. 3–15), in solar latitude 29° south; the time of central meridian passage was Nov. 9·5. The group, which was of 'stream' or 'bipolar' type, consisted of a very large circular spot with smaller followers. The leader, with an area of 800 millionths of the sun's hemisphere (800 millionths = nearly 950 million square miles), was the largest single spot observed since February 1931; the maximum total area of the present group was 1,200 millionths of the sun's hemisphere. On the few occasions when the weather permitted spectroscopic observations to be made at Greenwich, the group was not unusually active. Observations made on Nov. 9–11 show another large stream of spots extending in longitude for nearly 80,000 miles in lat. 21° north. The time of central meridian passage was Nov. 13·3. During the last two or three months there has been a marked increase in the sun's general activity, as shown by the increased frequency of spots—mainly of small or moderate size—dark and bright hydrogen and calcium markings on the disk and prominences at the edge of the disk.

Announcements

THE following have been elected as officers of the Cambridge Philosophical Society for 1935–36. *President:* Dr. F. W. Aston; *Vice-Presidents:* Prof. A. Hutchinson, Dr. E. D. Adrian, Sir J. Barcroft; *Treasurer:* Mr. F. A. Potts; *Secretaries:* Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. Hamshaw Thomas. *New Members of the Council:* Mr. R. A. Hayes, Dr. F. Kidd, Sir G. P. Lenox-Conyngham, Dr. R. G. W. Norrish.

THE fifth German Congress of the Scientific Associations on Corrosion will be held in Berlin on November 18–19. The theme of the Congress will be "The Corrosion of Metallic Materials of Construction by Cold Water". Further information can be obtained from the Verein deutscher Chemiker, Berlin W 35, Potsdamer Str. 103a.

MR. CYRIL C. BARNARD, librarian of the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, informs us that, in view of the numerous requests he has received for a copy of the classification used by him at that Library, he is considering the issue of a small edition in the form of a cloth-bound volume of 144 pp., royal 8vo., at 10*s.* 6*d.*, containing not only the schedules of the classification but also a full explanatory introduction, local list, index of parasites, and alphabetical subject index. Mr. Barnard can only undertake publication if sufficient promises of support are forthcoming.

THE following appointments have recently been made by the Secretary of State for the Colonies: F. J. Pound, to be agronomist, Department of Agriculture, Trinidad; N. H. Sands, to be agricultural officer, Malaya; F. W. Toovey, to be botanist, Department of Agriculture, Nigeria; W. E. Miller Logan, to be assistant conservator of forests, Gold Coast; A. C. Russell, to be assistant conservator of forests, Gold Coast; T. N. Wardrop, to be assistant conservator of forests, Nigeria; J. B. Alexander, to be geologist, Nyasaland; A. Cawley, to be engineering geologist, Tanganyika; W. H. Reeve, to be assistant field geologist, Tanganyika; B. N. Temperley, to be assistant field geologist, Tanganyika; W. J. B. Johnson, to be canning officer, Department of Agriculture, Malaya; A. A. Abraham, assistant agricultural superintendent, to be agricultural superintendent, British Guiana; G. W. Lines, late superintendent of agriculture, to be superintendent of agriculture, Nigeria; T. H. Marshall, senior agricultural assistant, to be district agricultural officer, Tanganyika; R. J. M. Swynnerton, agricultural assistant, to be district agricultural officer, Tanganyika.

THE Council of the Institution of Civil Engineers has decided that, in future, the Press can attend and report the discussions at any of the ordinary meetings of the Institution. Abstracts or advance copies of the papers to be read are available on application to the Secretary.

MESSRS. EDWARD ARNOLD AND CO. announce the early publication of a new edition of "The Structure of the Alps" by Prof. Leon W. Collet, of Geneva; and also "The Oyster and the Oyster Fishery" by Prof. J. H. Orton, of the University of Liverpool, embodying the Buckland Lectures for 1935.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant to the research chemist of the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Nov. 26).

An assistant lecturer and demonstrator in physics in the University of Leeds—The Registrar (Nov. 26).

A pomologist to the Royal Horticultural Society—The Secretary, Royal Horticultural Society, Vincent Square, Westminster, S.W.1 (Nov. 30).

A lecturer in geography and education in the University of Dublin—The Registrar (Dec. 2).

A professor of mining in the University of Edinburgh and Heriot-Watt College—The Secretary of the University (Dec. 31).

An assistant master to teach engineering in the Dover Technical Institute—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 798.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Electric Currents Flowing over Rusting Iron

THE electrochemical mechanism of 'rusting' is generally recognised, but our knowledge of the distribution and strength of the currents rests upon somewhat indirect methods. In the corrosion of a horizontal iron surface by filter-paper wetted with sodium bicarbonate solution, it has lately been found possible to study the current flowing horizontally through the paper without any interruption of the circuits. This is accomplished by shunting a small fraction through two non-polarising electrodes of superficially oxidised copper surrounded by filter-paper soaked in the same liquid and separated by waxed paper.

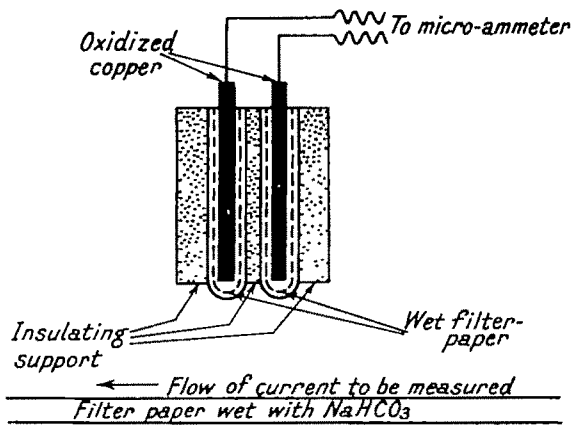

FIG. 1.

The apparatus, shown in Fig. 1, is mounted in a hinged frame, which allows it to be brought down momentarily at right-angles to the filter-paper in which the current is to be measured, and raised again as soon as the deflection of the micro-ammeter joined to the two coppers has been read—thus minimising disturbances to the corroding system. The relation between the deflection and the current to be measured is obtained by calibration on similarly wetted filter-paper strips through which known currents are forced from an external source. The form of the calibration curve indicates a satisfactory absence of polarisation, but calibration must be conducted before and after every experiment—as the sensitivity varies slightly with time; no great accuracy is claimed for the absolute values, but the general shape of the curves connecting current-strength and distance from the seat of corrosion is not in doubt.

Fig. 2 shows a curve obtained for soft iron corroded by $N/100$ sodium bicarbonate. The iron was abraded, degreased, exposed to dry air for 24 hours, and then a single scratch line was ruled across the centre just before application of the wet paper. Intense rusting quickly occurred along the scratch-line, and nowhere else. The change of the direction of the current near the scratch-line indicates that here the anodic (corroding) strip is surrounded by cathodic areas on *each* side. Since the difference (di) between the current-strength at two points separated by distance (dl) represents the current taken from or given up to the metal, the anodic or cathodic current

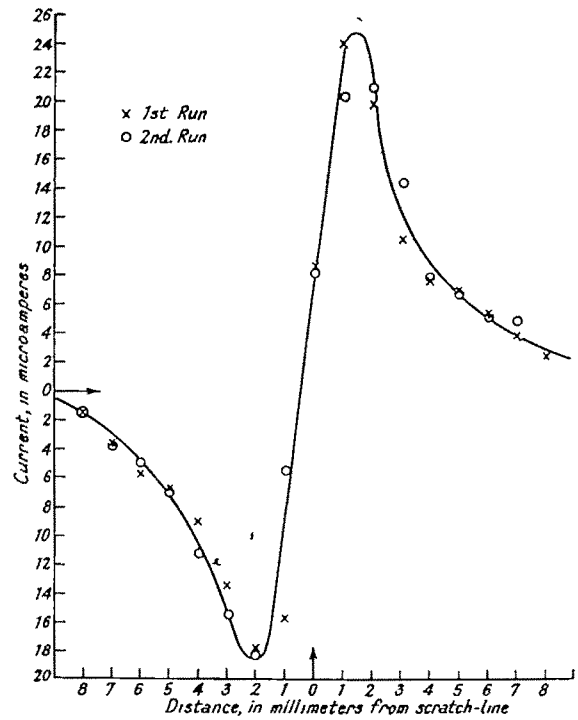

FIG. 2.

density, for a strip of breadth B, is represented by di/Bdl. Curve gradients sloping upwards to the right indicate *anodic* areas, and it will be noticed that there is intense anodic action immediately around the scratch, where corrosion is rapid; gradients sloping downwards to the right indicate *cathodic* areas, and these are free from attack.

Very similar curves have been obtained with irons of other purities, other surface conditions and other salt concentrations; but on some specimens (notably those of steel), rust appears not only along the scratch-line but also at isolated spots elsewhere; in such cases the curves show irregularities at the rusting points, important rust-spots being associated with

anodic gradients recognisable on the curves. Qualitative experiments without filter-paper on specimens covered with a layer of liquid and without a scratch-line indicate that here also corrosion is connected with electric currents, but the capillary disturbance of the liquid surface at the moment of tapping interferes with serious measurement.

The definite association of corrosion and immunity with well-separated anodic and cathodic areas, respectively, accords with the electrochemical mechanism of corrosion, as developed in previous papers with Bannister, Britton, Hoar, Borgmann, Mears and Lewis[1].

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University,
Cambridge.

[1] *Proc. Roy. Soc.*, A, 131, 355; 1931. 137, 343; 1932. 146, 153; 1934. *Trans Electrochem. Soc.*, 57, 407; 1930. 61, 441; 1932. 65, 249; 1934. *Trans. Faraday Soc.*, 30, 417, 424; 1934. 31, 527; 1935 *Korrosion u. Metallschutz.*, 6, 74, 178; 1930. 11, 121; 1935.

Absorption of Short Wave-length X-Rays

WE have recently had the opportunity of measuring the absorption coefficients of a number of substances for short wave-length X-rays. The radiations were produced at 250 k.v. (constant potential) using a filter of 3 mm. lead, 2 mm. tin and 3 mm. aluminium.

Spectroscopic evidence shows a narrow band of X-rays with a mean wave-length of 59 X.U. The measurements were carried out using a carefully controlled parallel plate chamber equipment with a compensation method of measurement as in setting up such apparatus for standardisation in roentgens[1]. Care was taken to reduce the scattered radiation entering the chamber, and the error in absorption coefficient due to it is estimated at not greater than two per cent. The absorption coefficients of a number of elements are given below.

Element	Form	Mass absorption coefficient μ/ρ	Electronic absorption coefficient $\times 10^{24}$
Lithium	Metallic blocks in petroleum	0·107	0·408
Beryllium	Powder	0·110	0·413
Carbon	Graphite blocks	0·123	0·407
Oxygen	Liquid	0·120	0·398
Magnesium	Metallic blocks	0·121	0·405
Aluminium	Metallic blocks	0·119	0·409
Sulphur	Powder	0·121	0·401
Calcium	Shavings	0·135	0·447
Iron	Sheet	0·138	0·490
Copper	Sheet	0·154	0·558
Selenium	Powder	0·168	0·645
Rhodium	Sheet	0·246	0·928
Palladium	Sheet	0·232	0·887
Tin	Sheet	0·310	1·213
Iodine	Crystals	0·325	1·282
Tantalum	Sheet	0·658	2·70
Platinum	Sheet	0·684	2 83
Lead	Sheet	0 847	3·53

The mean absorption per electron for light elements up to calcium is, for this wave-length, $4{\cdot}06 \times 10^{-25}$, in fair agreement with the predictions of the Klein-Nishina formula[2] ($4{\cdot}00 \times 10^{-25}$ for $\lambda = 59$ X.U.) This result is of some biophysical interest in view of the problems of the physical basis of the effects of such radiations on living materials[3]. The photo-electric absorption coefficient per electron μ_τ, defined by $\mu_\tau = \mu_e - 4{\cdot}06 \times 10^{-25}$ is found by us to vary according to the law $\mu_\tau = kZ^{3\cdot0}$, where k is constant and Z the atomic number of the element[4].

We have also measured, for the same wave-length, the absorption coefficients of two liquids containing hydrogen, namely, water and ethyl alcohol, as well as deuterium oxide. The values are given below.

Substance	μ/ρ	Form
Water	0·133	Distilled
Ethyl alcohol	0·142	A.R.
Deuterium oxide	0·118	99 per cent purity (Norwegian origin)

For short wave-lengths, the mass absorption coefficient for hydrogen should be approximately twice that of any other light element owing to the low ratio of atomic weight to atomic number. This appears in the results as an increase of 11 per cent in the mass absorption coefficient of water and 18 per cent for alcohol. Deuterium, on the other hand, would be expected to behave as a normal light element and this is verified in the value of μ/ρ obtained for deuterium oxide.

It may be observed that absorption measurements of this type serve to count electrons per atom, as distinct from the more usual method of weighing isotopic nuclei.

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[1] Mayneord and Roberts, *British Journal of Radiology*, 7, 158; March 1934.
[2] Lauritsen and Read, *Phys. Rev.*, 45, 433; April 1934.
[3] Mayneord, *Proc. Roy. Soc.*, A, 146, 867; Oct. 1934.
[4] Rutherford, Chadwick and Ellis, "Radiations from Radioactive Substances", p. 479.

New Technique for Obtaining X-Ray Powder Patterns

To obtain the X-ray diffraction pattern of a flat specimen such as is met with in metallurgical practice, the specimen may be mounted in a circular camera and inclined at a small angle to the beam. This is illustrated in Fig. 1. With the usual diaphragm, we have observed that diffraction lines making a small

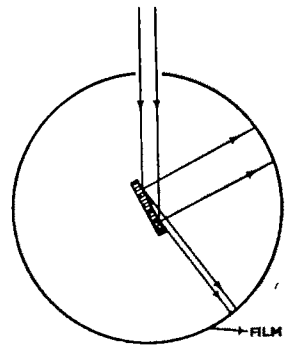

FIG. 1.

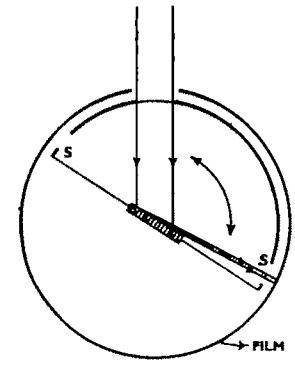

FIG. 2.

angle with the surface of the specimen are particularly sharp, but become broader as the angle between the diffracted beams and the surface of the specimen increases.

For a measurement one requires all the lines to be sharp, and so a camera according to Fig. 2 was devised, which can be used to record all or, if desired,

only a few reflections. In this camera, a shutter in which two slits, S, are cut, is arranged to rotate with the specimen, so that diffracted beams only reach the film when they make a small angle with the specimen surface.

To make full use of the principle, as wide a parallel beam as can be obtained from the focus of the X-ray tube is utilised. Very good results are obtained by means of a multiple diaphragm system as shown in Fig. 3.

If only a few lines, for example, within a region of 12° to 15°, are desired, the specimen may be kept stationary or, perhaps, oscillated over the region.

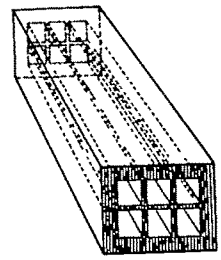

FIG. 3.

A useful application of the principle is to obtain a narrow intense beam of polarised monochromatic X-rays. A single crystal of copper cut with its plane surface at an angle of about 40° to the (311) plane is used as a polariser[1], and is irradiated by a wide beam of copper $K\alpha$ radiation (defined by a multiple diaphragm).

The advantages of the new method described above may be summarised as follows:

(*a*) a flat specimen such as is met with in metallurgical practice is used—this is an important point;

(*b*) the intensity of each line in the photograph can be calculated without difficulty—this is not so with the usual rod-shaped specimens;

(*c*) the sharpness of the lines can be controlled;

(*d*) in the case where the specimen is maintained stationary or oscillated over small angles, there is a much decreased time of exposure owing to the more efficient use of the available radiation.

Further details will be given elsewhere.

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[1] George, NATURE, 136, 180, Aug. 3, 1935.

Negative Attenuation of Wireless Waves

WE are interested in the measurements which Khastgir, Chandhuri and Sen Gupta described in a recent letter to NATURE[1], apparently confirming the occurrence of 'negative attenuation' of wireless waves first noticed by Ratcliffe and Barnett[2]. Some years ago, we attempted to extend the measurements which Ratcliffe and Barnett had made on the 1,600-metre transmissions from the Daventry Station of the B.B.C., so as to include measurements on the same wave-length but with a shorter transmitting aerial[3]. The results of these further measurements led us to question the interpretation of Ratcliffe and Barnett's results. We began by using measuring apparatus similar to that used in the original investigation, and consisting of a tuned loop circuit with a Moullin voltmeter placed directly across the tuning condenser. With this apparatus we reproduced the curve of Ratcliffe and Barnett quite closely. We then had occasion to make measurements with an apparatus in which the signal produced a deflection in a galvanometer attached to the output of an amplifier, this deflection being matched by injecting a calibrated E.M.F. into the loop circuit. This method of measurement showed no sign of the 'negative attenuation' effect. Closer investigation of the disagreement led us to the conclusion that the measurements made by the Moullin voltmeter method were vitiated by the fact that, owing to the flow of grid current, the damping which the voltmeter produced in the loop circuit was a function of the signal amplitude. The increased damping for the larger signals caused the signal strength to be progressively underestimated as the apparatus approached nearer to the emitter, and gave the appearance of 'negative attenuation'.

We were able to show that the magnitude of the apparent 'negative attenuation' effect was accounted for by the measured values of the grid current. We now believe that the apparent 'negative attenuation' observed by Ratcliffe and Shaw[4] with a wave-length of 30 metres is due to the same cause.

In the discussion of a paper read to the Institution of Electrical Engineers[5], attention was directed to the possibility of errors of this kind when using the Moullin voltmeter method.

When measuring with the injected E.M.F. method we have not been able to observe any 'negative attenuation' on 1,600 m. wave-length from the Daventry emitter, on 360 m. from Brookman's Park, or on 1,600 m. from an experimental emitter at Cambridge. We are therefore surprised that Khastgir, Chandhuri and Sen Gupta have observed the effect, and we wonder whether they, too, can have been misled by using the Moullin voltmeter method. We consider that their curves would have been more convincing if they had observed more points on the all-important rising part of the curve. It is unfortunate that the only measurement shown on this part of the curve is that at the origin; if for any reason this was in error, the whole nature of the curve would be altered.

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Halley Stewart Laboratory, King's College, London. F. W. G. WHITE.

[1] NATURE, 136, 605; Oct. 12, 1935.
[2] *Proc. Camb. Phil. Soc.*, 23, 238; 1926.
[3] NATURE, 125, 926; 1930.
[4] NATURE, 124, 617; 1929.
[5] *J.I.E.E.*, 70, 543; 1932.

Photochemical Reactions connected with the Quenching of Fluorescence of Dyestuffs by Ferrous Ions in Solution

IT has been found recently that ferrous ions exert a strong quenching effect on different fluorescent dyestuffs in solution[1]. According to previous theoretical discussions[2], in the elementary process of quenching, the light quantum ($h\nu$) is transferred from the excited dyestuff molecule ($D_s h\nu$) to the Fe^{++} ion by a collision of the second kind. Unlike the case of direct irradiation, when the Franck-Condon principle is observed, we can gain here some energy from the potential energy of the heavy particles. Thus in this case the hydration energy of the ions formed in the process and the binding energy between dyestuff and H-atom can be used according to:

$$(1)\quad Fe^{++}\ HOH + (D_s h\nu) = Fe^{+++} + OH^- + (D_s - H).$$

By irradiating different dyestuffs such as brilliant-cresylblue, methyleneblue, thionine, uranine (in water),

chlorophyll (in 60 per cent CH_3OH) in an (H_2SO_4) acid solution of $FeSO_4$ with the visible radiation of a strong carbon arc (oxygen being excluded) a considerable change in colour or bleaching is produced by the action of light, due to the formation of the reduced dyestuffs. The formation of these leuco-dyes takes place irreversibly, when the Fe^{+++} ions formed simultaneously are removed from the solution (for example, precipitated by hydrolysis). But with certain dyestuffs (for example, brilliant-cresylblue, methyleneblue, thionine) in acid solution the process is completely reversible in the dark, the Fe^{+++} formed being reduced by the leuco-dye. With these reactions it is proved that in general the binding energy between the radicals formed and the dyestuff can contribute an important part of the energy for the primary process of sensitisation (Reaction 1).

In analogy with other cases we have also been able to find the direct (unsensitised) photo-chemical process by irradiating an (H_2SO_4) acid solution of ferrous sulphate ($\frac{1}{2}$ molar) with ultra-violet light (from a strong mercury arc) which is strongly absorbed by the ferrous sulphate.

If oxygen is excluded, molecular hydrogen is formed in this process, with simultaneous formation of Fe^{+++} ions according to the electron affinity spectrum of Franck and Haber[3]:

$$(2)\quad Fe^{++}\,HOH + h\nu = Fe^{+++} + OH^- + H,\qquad 2H = H_2.$$

The quantum efficiency with respect to formation of molecular hydrogen was found to be of the order $\sim 0{\cdot}1$ (20° C.) and was practically independent of the concentration of the acid within the range $0{\cdot}08$–$0{\cdot}25$ molar H_2SO_4, but was strongly dependent on the initial concentration of ferric salt present in the solution. These facts indicate that a reverse reaction, the reduction of Fe^{+++} by H atoms

$$(3)\quad Fe^{+++} + H = Fe^{++} + H^+$$

plays an important part, competing with the recombination of the H atoms giving molecular hydrogen.

The reactions discussed above may be of some interest for certain biological problems.

The fact that by sensitisation in the presence of Fe^{++} ions it is possible to produce H atoms from water with the radiation of the visible spectrum (in spite of the binding energy H — OH being 115 k.cal.) may be of importance for the assimilation process of green plants (regeneration of the chlorophyll). Noack[4] recently found a relatively high content of ferrous compounds, present in simple inorganic form, in the chloroplasts of green plants.

On the other hand, the reversible bleaching of dyestuffs with light in the presence of the Fe^{++}/Fe^{+++} system can be regarded as the most simple model for the visual process.

I would like to thank Prof. F. G. Donnan for his continuous interest and valuable discussions.

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[1] J. Weiss, *Naturwiss.*, 23, 64; 1935.
[2] J. Franck and H. Levi, *Z. phys. Chem.*, B, 27, 409; 1935. J. Weiss, *Naturwiss.*, 23, 610; 1935.
[3] J. Franck and F. Haber, *Sitzungsber. Preuss. Akad. Wiss.*, 13; 1931.
[4] K. Noack, *Z. f. Botanik*, 23, 957; 1930.

Optical Rotatory Power of Solutions in an Electric Field

PREVIOUS work has shown that a relationship exists between the rotatory power of an optically active solution and the electric moment of the solvent. It has been found that, in general, the rotation varies in the opposite sense to the electric moment of the solvent throughout a series of solvents derived from the same parent hydrocarbon. An explanation of this observation has been advanced in terms of dipolar association between solvent and optically active solute, and numerous results have been brought forward in support of this hypothesis.

These observations suggested the possibility that an electric moment induced in the solvent molecules by an external electric field might have an effect similar to that of a permanent moment. Previous experience had shown that solvent influences are best observed with optically active compounds of simple molecular structure with a strongly polar group or groups situated near the asymmetric centre. For this reason, 2-*l*-menthyl-3-nitro-hydrogen phthalate was considered a suitable optically active solute, while solvents with zero or very small permanent electric moment were thought to be most advantageous for the proposed investigation; accordingly benzene and toluene were employed as solvents. Indeed, when an external electric field was applied to the solution, changes in rotatory power were observed. The tube with two parallel platinum electrodes, containing the solution, was placed in a Schmidt and Haensch half-shadow polarimeter reading to 0·01°. Rotations as large as 0·59° were obtained for the solution; the electric field was varied between about 500 and 11,000 absolute units. The rotation (change of rotation) increased at first slowly with increasing field, reached a maximum at about 4,000 absolute units and remained then constant, an effect which distinguishes this phenomenon clearly from the Kerr effect; but the two phenomena have in common that the effect is enhanced when the angle between the direction of the field and the plane of polarisation of the light is increased by rotating the tube in an anticlockwise direction. We expected this effect, that is, a decrease of the rotation, but we were surprised to find an increase in rotation by rotating the tube in a clockwise direction.

That the effect is not due to temperature changes in the solution is shown by the fact that in every case where a change due to the electric field was recorded, the change took place instantly and the rotation almost instantly returned to its original value, when the field was removed. These results have been repeated.

A solution of 2-ethyl-3-nitrohydrogen phthalate in toluene was submitted to an electrostatic field in the polarimeter tube. This compound is optically inactive and much less soluble in toluene than the corresponding menthyl ester. The solution was made by heating the ester and toluene, and while hot was poured into the tube; when under the influence of the field it was about 2 per cent with respect to the ester. The rotatory power was again a function of the potential difference between the electrodes, reaching a maximum at about 3,000 volts with both direct and alternating electric fields. It was very difficult to repeat these results, as the solution seemed to change continuously during the experiment. With the same field strength, the polarimeter readings were very erratic, for example, at one observation the

application of a field of 14,300 volts caused an instantaneous rotation of $\alpha = +3{\cdot}01°$, but in a few seconds, whilst the field was still on, it dropped to $\alpha = 0{\cdot}35°$. After the solution had been standing for three days, even the most powerful field had no effect on it; however, with a fresh hot solution rotational changes were again observed. The effects obtained with the ethyl ester appear to be distinct from those exhibited by the menthyl ester.

It is hoped to continue these investigations.

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Sept. 26.

Separation of the Mercury Isotopes by a Photochemical Method

WHEN a mixture of mercury vapour and oxygen is irradiated with the mercury resonance line λ 2537, the mercury becomes oxidised. Since excitation is a necessary stage in the oxidation, Mrozowski[1] has suggested that it should be possible to produce a separation of the mercury isotopes by exciting them selectively. If the reaction consists of the primary photochemical process

$$Hg^+ + O_2 \rightarrow HgO + O$$

only the atomic species which are excited by the incident light should be oxidised.

In my experiments the light from a mercury arc was passed through a Mrozowski filter[2] consisting of a column of mercury vapour in a magnetic field. This transmitted only the hyperfine structure components of the resonance line corresponding to the isotopes 200, 202. After an irradiation of between 10 and 30 minutes, the isotopic composition of the remaining mercury or of that recovered from the oxide was examined by the method of absorption of single hyperfine structure components[3]. The results of the experiments show:

(1) The separation is in every case only partial, so that besides the primary process, secondary reactions must take place.

(2) An addition of nitrogen assists the separation ($p_{O_2} : p_{N_2} \sim 1 : 1$, $p_{O_2} \sim 1$ mm. Hg).

(3) It has been possible to obtain samples in which the ratio $\frac{p_{200,\,202}}{p_{198,\,199,\,201,\,204}}$ was modified by a factor of four.

More detailed information will be published in the *Helv. Phys. Acta*.

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[1] S. Mrozowski, *Z. Phys.*, 78, 826; 1932.
[2] S. Mrozowski, *Bull. Acad. Pol.*, A, 404; 1930.
[3] K. Zuber, *Helv. Phys. Acta*, 8, 370; 1935.

Dissociation Energy of Carbon Monoxide

IN a former communication[1] we suggested 8·41 volts as the most probable value for the energy of dissociation of carbon monoxide. This was based upon a predissociation which we found in the upper level $B^1\Sigma$ of the Angström bands[2] and in the upper level $b^3\Sigma$ of the third positive group[3], at a height of 11·08 volts above the normal state of the molecule. Both predissociations we ascribed to the dissociation state ^3P (oxygen) + ^1S (carbon). To fix the dissociation energy with certainty, however, it is necessary to find another place of predissociation caused by a different state of the dissociation products.

An attempt in this direction was made by Schmid and Gerö[4]. They found predissociation in the higher level of the Herzberg bands at 0·48 volt above the predissociation mentioned above. This difference may be compared with that between two dissociation states of the molecule. As Fig. 1 shows, the difference between $^3P + {}^1S$ and $^1D + {}^1D$ is 0·53 volt, that between $^1S + {}^3P$ and $^1D + {}^1S$ is 0·46 volt. Schmid and Gerö believe that here the former difference must be taken, hence assuming an error of 0·05 volt, which is much larger than the triplet splitting in the atomic energy states concerned. Therefore we believe that the dissociation energy of carbon monoxide was still left uncertain.

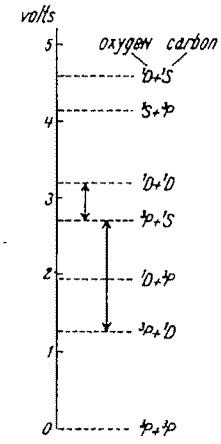

FIG. 1.

In examining the fourth positive group of CO, we found a sudden disappearance of the band lines in the bands with $v' = 10$, which points to a predissociation in the upper level $A^1\Pi$ of these bands. With the known band constants, the height of the dissociation state which causes this predissociation is calculated to be 9·66 volts above the normal state of the molecule. Comparing this predissociation with that in the upper level of the Angstrom bands at 11·08 volts, we find that the difference 1·42 volts corresponds exactly with that between the $^3P + {}^1D$ and $^3P + {}^1S$ states. Therefore we are sure of the following results: (1) the predissociation in the $A^1\Pi$ level is caused by $^3P + {}^1D$; (2) the predissociation in the $B^1\Sigma$ level is caused by $^3P + {}^1S$; (3) the dissociation energy of CO is 8·41 volts.

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[1] D. Coster and F. Brons, *Physica*, 1, 648; 1934.
[2] D. Coster and F. Brons, *Physica*, 1, 155; 1934.
[3] F. Brons, NATURE, 135, 873; 1935. L. Gero, *Z. Phys.*, 95, 747; 1935.
[4] R. Schmid and L. Gerö, *Z. Phys.*, 93, 546; 1935.

A New Technique in Cookery

THE leading article on "Food, Farmer and Future", by Prof. H. E. Armstrong, in NATURE of October 12, p. 565, encourages me to invite attention to what is, I believe, a new technique in the art of cooking.

It is commonly held that meat should be roasted in an oven at a temperature of 300°–500° F. and that the oven should be very hot for the first fifteen minutes so as to 'seal up the nutritive juices', particularly in the case of brown meat such as beef or mutton. It was, therefore, with some trepidation that my wife permitted a Sunday joint, a 6 lb. shoulder of mutton, to be put at 9 p.m. on a Saturday night into an oven thermostatically controlled at 212° F. She did not encourage me to experiment

with an expensive joint and the mutton cost 5½*d.* per pound. As things turned out this was fortunate, for we found that, despite its cheapness, the joint after fifteen hours cooking was delicious beyond all expectation.

The next experiment was with a boiling fowl which, when roasted in the same way for fifteen hours, was found to be as tender as a chicken and as full-flavoured as a turkey. Further tests with beef and mutton have confirmed the superfine quality of meat cooked at a low temperature, and the cooking of fish and other comestibles is now being studied.

It is important to observe that this method of cooking has been made practicable by the development of the heat-insulated thermostatically controlled oven. Strangely enough, however, it does not appear to have been discovered by the cookery schools or by the experts who advise the stove manufacturers.

In my household, the adoption of the new technique results in a saving estimated at not less than one penny per head per day: when it is realised that for the population of Great Britain a saving of one penny per head per day amounts to £70,000,000 a year, it is evident that scientifically directed experimental inquiry into the cooking of foodstuffs is of considerable economic importance.

In the great renascence promised by Prof. Armstrong we may find perhaps the answer to Rumford's question: "How many cheap articles may there be of which the most delicate and wholesome food might be prepared, were the art and the *science* of cooking them better understood?"[1]

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Oct. 14.

[1] "Essay on the Construction of Kitchen Fire-Places and Kitchen Utensils", 1802.

Dementia nomenclatorica americana

FOLLOWING upon the protests against the proliferation of nomenclature in the Foraminifera that have appeared in NATURE, I observe that in the fascicle of Protozoa in the "Zoological Record" for 1934 three hundred and fifty-four new genera, species and varieties are added to the nomenclature.

American protozoologists are not the only offenders (if offence it be), for no less than seventy-three of these new species are recorded in Part 3 of the "Discovery" Reports on the Foraminifera, published in 1934.

Now comes a letter from Dr. Hans E. Thalmann, the most diligent and accurate bibliographer of the Foraminifera since Dr. C. D. Sherborn, in which he says:

"With great interest I read a few weeks ago your article in NATURE and I would be more than glad if many of our American colleagues would read it earnestly as well. My 'Bibliography of Foraminifera for the year 1933' (at present in press) contains not less than 390 papers dealing with Foraminifera—and therein are published not less than about 40 new genera and subgenera, 390 new species and varieties. The manuscript for the year 1934 so far counts about 340 papers, 25 new genera, more than 300 new species. I am sure that more than 80 per cent of these so-called new species can easily be placed amongst already published forms, and that most of all the new generic names since 1927 have only subgeneric value. This *dementia nomenclatorica americana* is not only a serious problem to-day but will burden the poor minds of future workers in Foraminifera. It is really to be deeply deplored that at present only a few systematists and taxonomists realise the fact that nomenclature is *not* a science, but should be an aid to science."

EDWARD HERON-ALLEN.

Large Acres,
Selsey Bill,
Sussex.

Estimation of Ascorbic Acid by Titration

SOME time ago I observed an increase in the ascorbic acid value of cabbage on cooking[1]. McHenry and Graham[2] have found a similar increase in cauliflower, carrots, parsnips, beets and potatoes, though not in cabbage, and have expressed the view that the increase on boiling was due to the setting free of bound ascorbic acid, possibly from an ester. Van Eekelen[3], however, is of the opinion that the apparent increase is due to the destruction of an oxidase present in these vegetables.

Working with Darjeeling cabbage obtained from local markets, I have repeatedly obtained a very much increased ascorbic acid value by boiling for 10 minutes before extraction with 20 per cent trichloracetic acid. The value obtained in the cold is about 13 mgm. per 100 gm. vegetable, and increases to 40 mgm. per 100 gm. after boiling. Even boiling with water alone yields an appreciably richer extract than that obtained with cold trichloracetic acid.

It is evident that at least in this case no destruction of an oxidase is concerned, because in the cold the vegetable was ground up under 20 per cent trichloracetic acid. The view of McHenry and Graham may appear to be more plausible.

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[1] Ahmad, *Biochem. J.*, 29, 275; 1935.
[2] McHenry and Graham, NATURE, 135, 871; 1935.
[3] Van Eekelen, NATURE, 136, 144; 1935.

Presence of Roes in New Zealand Marlin Swordfishes

IN view of the scarcity of data on the breeding of marlin swordfishes, the following note may, perhaps, be of interest. Swordfishing has been a popular sport in this locality, the Bay of Islands, New Zealand, since 1911. Yet in spite of the fact that many fishermen and scientific workers have examined the fish caught, primarily to distinguish the sexes and, if possible, discover secondary sexual characters, no swordfish with ovaries containing roe had been discovered. With the view of increasing our knowledge of the breeding habits of these fish, I examined systematically a number of them, and on February 28 of this year dissected a Striped marlin, *Makaira* (*Tetrapturus*) *mitsukurii*, Jordan and Snyder, weighing 238 lb., which contained well-filled, firm ovaries measuring approximately 37 cm. in length and 5·5 cm. in diameter in the widest part. The ova were separate and measured 0·004 inches. On April 3, I examined the roes of another Striped marlin of similar proportions. These fish seemed to exhibit no outstanding sexual characteristics.

In the previous month, however (March 12), a Black marlin, *Makaira* (*Tetrapturus*) *mazara*, Jordan and Snyder, had been caught, of the roes of which I have samples. This fish, weighing 436 lb., had roes containing ova of about the same size as those previously mentioned, but departed from all Black marlin previously caught in that it possessed a black dorsal band extending downwards for about six inches, the remainder of the sides and belly being silvery. Black marlin usually seen in this locality are of a dark, blackish-purple colour, fading gradually to a white ventral line.

V. W. LINDAUER.

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Aug. 10.

Cleopatra's Temple at Armant

THERE existed at Armant until the year 1861 an extremely interesting temple built by Cleopatra the Great in honour of the birth of her son Caesarion. This was completely demolished between the years 1861 and 1863 and the materials were taken and used in the construction of a sugar factory; but, prior to that date, it had been visited and described by many travellers and fortunately, a number of drawings, plans and photographs of it were taken by them. We are engaged upon a reconstruction of this temple for publication and we should be very grateful for any help which readers of NATURE may be able to give us to make this as complete as possible. Any information about unpublished descriptions, plans, drawings or photographs of it would be of the greatest value.

A large number of travellers toured this part of Egypt in the eighteenth and nineteenth centuries, when the diary habit was strong, the standard of draughtsmanship high, and towards the end of the temple's existence, photography was just becoming popular. We believe that there may well remain important records in private collections which would be of great assistance in making some restitution for the vandalism of the last century.

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Points from Foregoing Letters

DR. U. R. EVANS illustrates an experimental arrangement which enables him to investigate the electric currents flowing over an iron surface in contact with bicarbonate solution during the process of rusting. The results obtained show intense anodic action immediately around a scratch where rusting is rapid, while the cathodic areas are free from attack.

Measurements by Dr. W. V. Mayneord and J. E. Roberts of the absorption of short wave-length X-rays (59 X.U.) indicate for elements of low atomic weight good agreement with the theoretical predictions of Klein and Nishina. For heavier elements the photo-electric absorption per atom is proportional to the fourth power of the atomic number. Owing to its large electronic content per unit mass, hydrogen has a larger absorption coefficient than other light elements. Deuterium proves, however, to be, from this point of view, the 'normal' light element.

A new technique for obtaining X-ray powder photographs from flat specimens is described by R. A. Stephen and R. J. Barnes. The principle also finds an application in obtaining an intense beam of monochromatic polarised X-rays.

Khastgir, Chandhuri and Sen Gupta have recently confirmed the negative attenuation of wireless waves, first described by Ratcliffe and Barnett. J. A. Ratcliffe and F. W. G. White point out, however, that upon further investigation they have found that the original results were due to the use of a Moullin voltmeter, which vitiated the experiments. They inquire, therefore, whether the results obtained by the Indian experimenters may not be similarly explained, and further suggest that more points might suitably be obtained by them on the rising part of the curve.

Dr. J. Weiss directs attention to a possible analogy between the reversible photochemical reaction involved in the bleaching of dyestuffs such as methylene blue by visible light in the presence of ferrous ions, and processes taking place in the retina; also between the production of hydrogen under the same conditions, atoms from water (in spite of the high energy needed) and the assimilatory process in green plants. In addition to these *sensitised* reactions in which the potential and binding energy of the heavy particles play a part, J. Weiss states that he has detected the *unsensitised* photochemical process by irradiating an acid solution of ferrous sulphate with ultra-violet light from a mercury lamp.

By placing a solution of the optically active and strongly polar compound 2-*l*-menthyl-3-nitro-hydrogen phthalate in benzene or toluene, in an electric field, Prof. J. Kunz and A. McLean have observed changes in the optical rotatory power. The change in rotation reaches a maximum when the strength of the field is 4,000 absolute units, which distinguishes the phenomenon from the Kerr effect. The authors ascribe the effect to the electric moment induced in a solvent by the electric field. Anomalous effects were observed with 2-ethyl-3-nitrohydrogen phthalate.

Taking advantage of the fact that ultra-violet light of wave-length 2537 excites and oxidises mercury atoms of mass 200 and 202 but not those of mass 198, 199, 201 and 204, Dr. K. Zuber has succeeded in producing a partial separation of ordinary mercury into fractions richer in those two groups of isotopes. The presence of nitrogen assists in their separation.

The structure of the fourth positive group of bands in the spectrum of carbon monoxide provides, according to F. Brons, definite confirmation that the dissociation energy of carbon monoxide is 8·41 volts, as has previously been suggested by Coster and Brons.

The amount of ascorbic acid (vitamin C) found in Darjeeling cabbage after boiling for ten minutes is greater (as in the case of other vegetables) than the amount obtained by extraction in the cold with 20 per cent trichloracetic acid. This, B. Ahmad considers, supports the view of McHenry and Graham, who ascribe the increase to the setting free of ascorbic acid from an ester compound, as against van Eekelen's opinion that the increase is only apparent and is due to the destruction of an oxidase ferment.

Research Items

Archæology in Australia

MR. D. S. DAVIDSON, who from April until July, 1930, was engaged in archæological reconnaissance in the Katherine River–Victoria River region of North Australia for the Museum of the University of Pennsylvania, points out in a discussion of the problems to which his investigations have given rise (*J. Roy. Anthrop. Inst.*, 55, pt. 1) that very few serious attempts at excavation have been made, the few of any importance being those sponsored by the South Australian Museum. The absence of pottery and the nomadic habits of the aborigines make the location of a site a matter of difficulty, but the desert areas offer compensation in the preservation of objects perishable elsewhere. The use of caves in the wet season and of rock-shelters has provided material for investigation, but the aboriginal practice of burying implements and personal belongings for safe-keeping is a disturbing factor in stratigraphic study. Of the caves examined, some were still in occupation. It was not possible to estimate the antiquity of the material found. Natives must have inhabited the area for thousands of years, but the cave deposits give the impression that they might have been built up in a few centuries. The classes of objects found were not numerous. One of the problems of the future will be to distinguish important localised types. A tentative classification suggests that the 'pirioid' type of adze point appears to antedate the use of quartzite spear-heads, while these quartzite spear-heads quite definitely antedate the type of blade which is a product of the pressure flaking technique. This appears to be a fairly recent product as its use is only now spreading to north and central Australia, among the tribesmen of which the technique appears to have been unknown previously, while the former, the quartzite spear-head still in use, is the only one of the two occurring archæologically.

Serbian Gypsy Cult of the Anvil

DR. ALEXANDER PETROVIČ, in continuation of his study of the gypsies of Serbia and Bosnia, has described their cult of the anvil (*J. Gypsy Lore Soc.*, Ser. 3, 14, Pt. 4). The gypsies of Rogatica make their own anvils, buying good iron or steel. Prayer precedes the making; and when the anvil is made it is wrapped in rags and brought into the tent where none may see it, until the appointed day, when the maker gives a feast and a sheep or hen is slaughtered. The anvil is exhibited after dinner, surmounted by three lighted candles, of which one has been saved from the preceding feast of St. Elias. After prayer, the anvil is struck for the first time with a hammer, and those present offer gifts of coin, gold if possible, with exclamatory wishes of good luck. During the rest of the day, neighbours come in to look at the anvil and make similar gifts. In olden times payment for any work done was not given to the smith, but placed on the anvil. On St. George's Day it is decorated with young boughs; and on St. Elias's Day and New Year's Day a lighted candle is stuck in the hole, again with an expression of good luck. When a young boy was apprenticed one of his fingers was placed on the anvil and struck three times with the hammer. The anvil was definitely regarded as sacred. An old anvil is never thrown away, but kept in the house "like an old man or an old woman". In cases of theft, suspected persons swear their innocence by the anvil, which is set up in the yard in front of the house of the injured party, surmounted by a lighted candle, some salt and a piece of bread. At Mirijevo, near Belgrade, an axe takes the place of the anvil. As sacred, the anvil and everything connected with the forge were believed to have healing powers. The water in the tub by the anvil, in which the heated iron is plunged, is holy and is given as medicine to both cattle and human beings. A similar cult and oath are found among other gypsies in connexion with the fiddle and money. It is thus evident that the Serbian gypsies venerate and regard as holy that by which they earn their living.

Noise and Efficiency in Works

REPORT No. 70 of the Industrial Health Research Board ("Conditions of Noise", by H. C. Weston and S. Adams) describes an experiment that has been made to test the effect of continual noise upon the efficiency of weavers. Noise is first defined as unpleasant or disturbing sound, such as obtains in the weaving sheds. Two groups, of the same efficiency, worked first for six months and then for a year in the same conditions and with the same materials. One group, of ten men, was exposed to the usual noise. The other, also containing ten men, was given ear-defenders which reduced the intensity of noise by 15 decibels or half the apparent loudness. At first the increased personal efficiency in the protected group was considerable. It became less so afterwards, but the average increase remained as high as 7½ per cent in the latter part of the experimental period. A similar experiment in 1932 rated the increase at 12 per cent, but possibly the conditions were more favourable. The workers liked wearing the ear-defenders, and even those accustomed to the noise and immune from its effects in respect of irritability and distraction were increased in efficiency. It is impossible, however, to infer from this experiment the value of decreased noise in cases where the work is different and the initial noise less.

Japanese Bopyrids

S. M. SHIINO describes a large number of Bopyrids in two papers, Bopyrids from Tanabe Bay (1 and 2) (*Mem. Coll. Sci., Kyoto Imp. Univ., B*, 8, No. 3, 1933 and 9, No. 4, 1934). Twenty-eight species are described, eighteen of which are new. It is a most interesting collection and several peculiar features are pointed out. Of the branchial parasites, a large number inhabit hermit crabs, but several other groups are parasitised, including two *Penæopsis* and a *Solenocera*. The abdominal parasites are not so numerous. *Bopyrina giardi* Bonnier is recorded from *Hippolyte* sp., its general constitution being largely in accord with the characters given by Bonnier for the European form, but there are certain differences, notably that of the male cephalon being fused with the first thoracic segment in those from Japan, whilst it is separate in those from Europe, and anal spines are present in the latter, absent in the former. Four females, each carrying a male, were found in

the branchial cavity of one *Hippolyte*. The male has a coloured pattern on both dorsal and ventral surfaces. A common species inhabiting the left branchial cavity of the hermit-crab *Olibanarius bimaculatus* is a new species of *Pseudione*, *P. clibaricola*. It never occurs in the right cavity, which is sometimes occupied by another type of Bopyrid, also a new species, *Pseudione asymmetrica*, and this is never found on the left side. Sometimes both species are found in the same individual.

Movements of Copepods

THE importance of copepods in the ecology of fresh- and salt-waters is well established, but little is known of the actual mechanism of their swimming movements or of their methods of feeding. A recent paper by A. G. Lowndes ("The Swimming and Feeding of certain Calanoid Copepods". *Proc. Zool. Soc. London*, Part 3, 687–715; 1935) is therefore especially welcome. By a variety of methods, including the polygraph process and ultra-rapid photography with exposures up to 1/30,000 of a second, the movements of the appendages were examined in seven of the commoner marine species and three species of fresh-water copepods. Much evidence is brought forward to show that feeding cannot be regarded as purely automatic or non-selective. In this connexion the observation that *Diaptomus gracilis* caught in a pool, the waters of which were green with unicellular algæ, had been feeding on desmids on the bottom is of special interest. In this paper the author supports the theory that the Centropagina are a more primitive group of copepods than the Calanina. The theory is favoured partly on the grounds that their predatory method of feeding can be regarded as more primitive than the more highly specialised filter feeding. All observations were made with the animals living free in a large body of water approximating so far as possible to their natural environment. Much information is given on the rate of movement of limbs and the actions of the animal. It cannot be too strongly stressed that observations of this nature should prove invaluable in the elucidation of the habits and migrations of copepods as shown by field collections.

Growth Records on Fruit Trees

ONE of the difficulties encountered in pomological research is the amount of time and labour involved in the collection and recording of large numbers of data relative to the growth and fruit production of apple trees. A census method which reduces to a minimum the labour of recording summer growth has been developed by M. C. Vyvyan at the East Malling Research Station (*J. Pomol. and Hort. Sci.*, 13, 202; 1935). Various well-defined growth structures on the tree are classified into categories such as bearing or non-bearing, short or long, growing or non-growing, etc., each of which is denoted by a letter of the alphabet as a distinguishing symbol. The recorder examines each growth from the apex to the base of the tree or sample branch and calls out the corresponding symbols in order. These are then recorded and the numbers in each category counted simultaneously by the use of an ingenious combination of typewriter and reset counters. The result is a typewritten map of the whole tree forming a permanent record of the various growths and their positions, and this can be expanded at successive periods as growth proceeds.

Prediction of Rubber Yield

ONE of the chief problems confronting the rubber research worker is the length of time needed before reliable results as to the yield capacity of the plant can be obtained. The tapping test that is usually employed, conclusive as it is, is only applicable when the latex system is sufficiently developed, that is, a period of seven or more years has to elapse before comparative tests and selection of clones can be carried out. Genetical work is in consequence seriously hampered. A new method, however, has recently been evolved by H. Gunnery (*J. Rubber Res. Inst.*, 6; 1935), by which the yield can be accurately predicted at an early stage in the life-history of the plant. A detailed study of the anatomical structure showed that two distinct types of sieve tubes occur, one of small, the other of large, diameter. The latter are invariably associated with latex vessels of wide bore, that is, occur in trees of high-yielding capacity, while the small type of sieve tube is found in low-yielding trees in conjunction with small bore latex vessels. Further, the type of sieve tube is constant in all parts of the plant and at all ages. By means of qualitative analyses of the phloem of young *Hevea* seedlings, therefore, low-yielding individuals may be eliminated at a very early stage, and much valuable time saved in all work of a selective nature.

Glacial Geology of Yorkshire

IN "The Glacial Geology of Holderness and the Vale of York" (published by the author, 61 Carr Lane, Acomb, York, 1935, price 4*s*.; cloth 5*s*.), Mr. Sidney Melmore gives a scholarly and conscientious review of the glacial problems in an important area. The boulder clays, buried cliff and raised beaches of Holderness, the Speeton shell-bed, the Kelsey Hill deposits (with list of fauna), the moraines and drift and high-level flanking deposits of the Vale of York, the Kirkdale bone cave, the Leeds hippopotamus, the relation between rivers and joints in the country rock, and many other topics of interest are treated from a historical point of view. The author's method of approach gives full credit to the achievements of the pioneers, Sedgwick, Buckland, Phillips, Prestwich, and to other workers such as Dakyns, Reid, Lamplugh. His quotations at the chapter headings alone would form an interesting short history of the progress of investigation. The division of the matter into numerous small chapters makes for freshness and easy reference; and the two dozen maps and diagrams are all that could be desired.

Effect of the Moon on Barometric Pressure

"THE Lunar Atmospheric Pressure Inequalities at Glasgow", by R. A. Robb and T. R. Tannahill (*Proc. Roy. Soc. Edinburgh*, 4, Part 1, No. 9), is a paper dealing with the effect of the moon on barometric pressure at Glasgow Observatory deduced from an analysis of a record, extending from 1868 to 1912, of hourly values of atmospheric pressure recorded photographically, and checked by daily control readings of a standard barometer at 10h, 12h, 14h, 18h and 22h G.M.T. A rough examination of these records had shown a strong diurnal variation, an effect at variance with determinations of the harmonic coefficients at other places made by Chapman, who found the semi-diurnal coefficient to be the chief one, giving an amplitude of 0·012 at Greenwich, 0·083 at

Batavia and 0·060 at Hong-Kong. In order to reduce accidental variations, Robb and Tannahill rejected all days on which the difference between the pressure at two successive upper transits of the moon exceeded 0·1 inches of mercury. Nine groups of observations were obtained by dividing the 45 years into three equal periods, into three seasonal groups—winter (Nov.-Feb.), equinoctial (March, April, Sept. and Oct.) and summer (May–Aug.), and three groups for which at the initial lunar upper transit the lunar semi-diameter was equal to or less than 14·99′, 15′–15·99′ and equal to or greater than 16·00′. The hourly inequalities for these groups and for the total data were corrected for any known variations with solar time that might, owing to the selection of data, have been only partially eliminated. The harmonic analysis of the corrected hourly inequalities gave for the whole period the following values for the first three Fourier terms:

$$0{\cdot}0640 \sin(\theta + 267^\circ) + 0{\cdot}0156 \sin(2\theta + 285^\circ) + 0{\cdot}0089 \sin(3\theta + 292^\circ),$$

where the amplitude is in millibars and θ is reckoned from upper lunar transit. Estimates of the probable errors of the coefficients appeared to establish the reality of the first two, and the preponderance of the diurnal over the semi-diurnal variation at Glasgow accordingly appears to be a real phenomenon, for which no satisfactory explanation is offered.

Dielectric Constants of Liquids at Radio Frequencies

IN a paper published in *Hochfrequenztechnik und Elektroakustik* (46, 92; 1935), Dr. D. Doborzynski describes a somewhat novel method of determining the dielectric constant of non-conducting liquids at radio frequencies. The innovation consists in making use of the carrier waves of known frequencies received from broadcasting stations in place of a local source of oscillations. A tuned receiving circuit is set up with a main variable condenser in parallel with another variable condenser of small capacitance. For a fixed setting of the main condenser, the four frequencies required are those corresponding to the maximum and minimum settings of the small condenser, first with this in air, and next with it immersed in the liquid under examination. These frequencies are determined by simple interpolation over a small portion of the scale of the main condenser. Since it is known that, at the present time, most broadcasting stations attain a frequency constancy of an order better than 3 parts in 10^4, it is considered that in the neighbourhood of 1,000 kc./sec., the above four frequencies can be determined to within $\pm$ 0·25 kc./sec., resulting in an overall accuracy of the dielectric constant determination of better than one per cent. The method has been applied to the measurement of the dielectric constant of benzol and nitrobenzol at 20° C., the values obtained being 2·29 and 34·5 respectively. The possibility of extending the method to conducting liquids is now being explored.

Radioactivity of Actinium

ALTHOUGH actinium was discovered in 1899 by Debierne and has been much studied since, all attempts to find any effect due to the radiation from actinium itself have so far failed. The fact that the direct descendant of actinium is radioactinium, an isotope of thorium, indicates that a β-particle must be emitted in the disintegration of actinium, and since this has not been discovered experimentally it has been assumed that it is emitted with very low energy. The discovery by Sargent in 1933 of the relation between the decay constants of β-emitters and the upper limits of their energy spectra made the behaviour of the actinium β-particle seem anomalous. The modification of the tube counter devised by Libby, in which a screen is substituted for the usual solid wall, makes it possible to detect electrons of very low energy, and D. E. Hull, W. F. Libby and W. M. Latimer (*J. Amer. Chem. Soc.*, 57, 1649; 1935) have in this way detected the β-radiation of actinium. The radiation is half-absorbed in 0·0023 gm./sq. cm. of aluminium and is easily deflected in a magnetic field. The maximum energy of the β-particles is about 220,000 electron-volts, which fits well on the lower Sargent curve. The paper contains full details of the chemical methods of purification of the actinium, the most difficult problem being the removal of radioactinium. Co-precipitation with thorium perhydroxide was the method finally adopted. The radiation was identified as due to actinium itself by the excellent agreement between the theoretical and experimental growth curves.

Thermal Data for Purine Derivatives

THE importance of the thermal data for purine derivatives in biochemistry is recognised, so that some recent accurate determinations in this field are of interest. R. D. Stiehler and H. M. Huffman (*J. Amer. Chem. Soc.*, 57, 1734; 1935) have measured the heats of combustion and heat capacities of adenine, hypoxanthine, guanine, xanthine, uric acid, allantoin and alloxan, and from the results have calculated the heats of formation, entropies and free energies. All the compounds except adenine had been previously burned by earlier workers, and discrepancies of 0·1–2 per cent with the older data are found. The measurements were made with the best modern technique and the results may be summarised as follows. The free energy values are believed to be accurate to 300–600 gm. cal. The data are at 298·1° Abs. The heats of combustion, in k.cal., are at constant pressure and the water liquid, per mole.

	Heat of combustion	Free energy Δ F.° (in gm. cal.)
Adenine	663·74	70,420
Hypoxanthine	580·20	17,250
Guanine	596·89	10,220
Xanthine	516·02	− 40,730
Uric acid	458·84	− 91,460
Allantoin	409·55	− 107,470
Alloxan	273·58	− 182,880

When the free energies are compared, some interesting facts are brought out. In going from adenine to hypoxanthine and from guanine to xanthine, both of which involve the same type of deamination in different parts of the six-membered ring, decreases of 53,170 and 50,950 gm. cal., respectively, are observed. In the changes adenine to guanine and hypoxanthine to xanthine to uric acid, all of which reactions involve the addition of an oxygen atom and a shift of a hydrogen with the corresponding opening of a double bond, the free energy decreases are, respectively, 60,200 gm. cal., 57,980 gm. cal. and 50,730 gm. cal. These changes indicate that, in the crystal at least, the bond energies are distinctly affected by their positions in the compounds.

British Medical Association

ANNUAL MEETING AT MELBOURNE

THE one hundred and third annual meeting of the British Medical Association was held in Melbourne, Australia, during the week commencing September 9, under the presidency of Sir James Barrett of Melbourne. This is the first occasion on which the Association has met in Australia. In spite of its remoteness from the Old World, the meeting was one of the largest, if not actually the largest, in the history of the Association. The total number of registered attending members was nearly 1,500; and there were more than 300 overseas visitors. Of the many distinguished visitors from Great Britain may be mentioned Lord Horder, Sir James Purves-Stewart, Sir Thomas Dunhill, Sir Ewen Maclean, Sir William Willcox, Sir Henry Gauvain, Prof. Edwin Bramwell, Prof. Hey Groves, Prof. A. M. Drennan, Mr. H. S. Souttar, Dr. J. S. Fairbairn, Dr. Robert Hutchison, Dr. S. Watson Smith (the retiring president), Dr. E. Kaye le Fleming and Dr. E. W. Fish. Members of the Association from South Africa, Egypt, India, Ceylon, Canada, New Zealand, Holland, China and Japan were present.

The adjourned annual general meeting took place on September 10 in the Town Hall, in the presence of Their Excellencies the Governor General of the Commonwealth, Sir Isaac Isaacs, and Lady Isaacs, and His Excellency the Governor of Victoria, Lord Huntingfield, and Lady Huntingfield. The principal events of the meeting were—an opening address by Sir Isaac Isaacs; induction of the new president, Sir James Barrett, who delivered his presidential address on the subject of hospital policy in Australia; the transmission to His Majesty the King of a message of loyalty from the Association, to which a reply was received before the meeting ended; and presentation of the flag of the City of Melbourne to the Association by the Lord Mayor.

A meeting of the Royal Australasian College of Surgeons took place on September 12, under the presidency of Mr. R. B. Wade. Honorary fellowships were conferred on Prof. Hey Groves and Mr. H. S. Souttar; and Prof. Hey Groves delivered the first Hamilton Russell Memorial Oration, entitled "The Romance of Surgery".

Before describing the discussions of the scientific sections, it is appropriate to mention the 'museum' which was housed in the University Anatomy School. The remarkably comprehensive and beautifully displayed collection was assembled specially for the occasion by a committee of which Prof. F. Wood Jones was chairman and Dr. E. S. J. King secretary. The exhibits embraced almost the entire range of human pathology as well as certain aspects of anthropology, parasitology, radiology and public health. Many of the exhibits were designed to form an illustrative accompaniment to some of the sectional discussions. On four mornings during the week, demonstrations of special subjects in the museum were given by the exhibitors.

The Section of Medicine, presided over by Lord Horder, discussed obesity, anæmia, and, on the third day in conjunction with the Section of Surgery, thyreotoxicosis. Other subjects dealt with in occasional papers were diabetic gangrene, hæmolytic jaundice and gallop rhythm of the heart. The most interesting discussion was that on thyreotoxicosis along with the surgeons, a meeting which had an attendance of nearly six hundred, easily a record for a sectional meeting. Lord Horder and Sir Thomas Dunhill opened the discussion. The principal point emerging, and one which was particularly stressed by Lord Horder, was that the pathogenesis of thyreotoxicosis is still unknown, and that the beneficial results of thyroidectomy do not necessarily justify the conclusion that the condition is one of primary thyroid dysfunction.

The Section of Surgery, with Sir Thomas Dunhill as president, discussed hydatid disease, the surgery of the pancreas, prostatectomy, cancer of the colon, and, along with the Section of Medicine, thyreotoxicosis. Apart from the last, the most notable debate was that on hydatid disease, opened by Prof. H. R. Dew. Almost all aspects of this subject were embraced in the course of the discussion; which was well supplemented by the excellent collection of specimens of hydatid lesions and the life-history of *Tænia echinococcus* which were available for study in the special museum already described.

The Section of Obstetrics and Gynaecology, under the presidency of Dr. J. S. Fairbairn, discussed Cæsarean section, placenta prævia, the late toxæmias of pregnancy, and the remote results of puerperal sepsis. With respect to Cæsarean section, there was a decided opinion, voiced particularly by Dr. J. Bright Banister, that this operation was often too lightly undertaken without adequate reason, and that there was need of careful formulation of the indications justifying the operation.

The Section of Radiology and Radio-Therapeutics, with Mr. H. M. Moran presiding, discussed radiation treatment of cancer of the breast and of cancer of the tongue, radiological diagnosis of diseases of the lung, diagnosis of bone tumours, radiological education and skiagraphic examination of the stomach and duodenum. The work of the section was well supplemented and enhanced in value by a series of skiagrams illustrating the several subjects, which were displayed in the museum. The discussion on the diagnosis of bone tumours, opened by Dr. H. R. Sear, was of particular interest, as it emphasised the importance of recognising various types of metastatic tumours which might simulate primary tumours of bones.

The Section of Diseases of Children, with Dr. Robert Hutchison as president, discussed hare lip, infant feeding, pink disease and intussusception. The discussion on pink disease, opened by Drs. A. J. and I. J. Wood, provided a very complete epitome of existing knowledge of this illness, the pathogenesis of which is, however, still unknown.

The Section of Neurology and Psychological Medicine was presided over by Prof. Edwin Bramwell. Its first session was devoted to a consideration of the diagnosis, prognosis and treatment of brain tumours fifty years ago, and now. Prof. Bramwell's opening paper on this topic provided an excellent

survey of the growth of our clinical knowledge of brain tumours. Advance has come principally through the use of special methods of clinical investigation, from the introduction of the ophthalmoscope up to our present-day use of such methods as ventriculography and encephalography. The second session of the section discussed the psychoses of adolescence, and the malarial treatment of neurosyphilis, the latter subject being illustrated by exhibits in the museum.

The Section of Ophthalmology, under the presidency of Dr. A. J. Ballantyne, discussed glaucoma, false binocular projection and abnormal retinal correspondence, idiopathic cyclitis and several minor subjects. On all the topics, the discussions were of considerable interest, and contained original work or ideas.

The Section of Orthopædics, presided over by Prof. Hey Groves, discussed fractures of the neck of the femur, osteoarthritis of the hip and knee, fractures of the spine, and the role of physiotherapy in orthopædic practice.

The Section of Oto-Rhino-Laryngology, under Mr. F. Muecke, considered maxillary and nasal sinusitis, chronic suppurative otitis media, sphenoidal sinusitis in relation to the pituitary gland and actinotherapy in laryngeal tuberculosis.

The Section of Pathology and Bacteriology was presided over by Prof. A. M. Drennan. At its first session various aspects of pathological calcification and bone disease were discussed, the principal paper being one on the pathology of osseous tissue by Prof. Drennan. A paper on leukæmic infiltrations was read by Prof. J. B. Cleland; and one on the neural components of teratomata, by Dr. R. A. Willis, this being amplified by photographs and maps exhibited in the museum. The second meeting of the section was largely devoted to bacteriology. A discussion on anærobes in disease was opened by Prof. H. A. Woodruff with an informative paper on anærobic infections in animals; and Dr. F. M. Burnet introduced a discussion on virus diseases, stressing the frequent occurrence of mild, but immunising, attacks of these and other infections. A new method of hæmoglobin estimation, based on the formation of globin picrate, was described by Dr. Bolliger.

The Section of Pharmacology, Therapeutics and Anæsthesia, under the presidency of Sir William Willcox, discussed hypnotic drugs, urinary antiseptics, premedication and basal narcosis, gas anæsthesia, and spinal anæsthesia; and Prof. W. A. Osborne contributed a paper on a vaso-constrictor principle in the frog's skin.

The Section of Public Medicine, under Sir Henry Gauvain as president, dealt with tuberculosis, industrial and tropical medicine, and racial problems. At its first meeting the subject of pleural effusion in artificial pneumothorax was introduced by an informative paper by Dr. D. B. Rosenthal; and Mr. M. P. Susman opened a discussion on tuberculous empyæma. At the second meeting of the section, which was combined with the Section of Medical Sociology, the principal subject was racial pressure problems in Australia and its neighbourhood, opened by Sir R. W. Cilento.

The Section of Medical Sociology, with Dr. E. Kaye le Fleming as president, discussed the Australian medical aerial services, the social aims of mental hygiene, and along with the Section of Public Medicine, racial pressure problems opened by Sir Raphael Cilento. Sir James Barrett spoke of the difficulties of agricultural and pastoral activity in the Northern Territory, pointing out that on parts of the south coast of Java, which has a population of forty million people, areas resembling northern Australia are reported to be practically empty, and that for successful agriculture a rainfall of at least ten inches in the dry season is essential. Sir James Barrett then quoted an article by Mr. Wynne Williams, from the last number of the *Economic Record*, to the effect that apart from Queensland, Northern Australia is economically incapable of carrying a large population of any race. The difficulty is not physiological but entirely economic.

The Section of Dermatology was presided over by Dr. S. Watson Smith. The principal subject for discussion was the incidence of skin diseases in Australia, opened by Dr. Herman Lawrence. A main point brought out was the exceptionally high incidence in Australia of keratosis, rodent ulcer and epithelioma—called by Dr. Lawrence the "epithelial triad" and attributed by him largely to sunlight. An account of staphylococcal skin infections by Dr. Ivan Connor indicated the value of treatment by toxoids. Dr. J. C. Belisario contributed a paper on fungus infections.

Lumière and the Invention of Cinematography

A BRILLIANT gathering took place on the evening of November 6 at the Sorbonne, in honour of M. Louis Lumière, father of the cinema and of many other inventions in the field of photography.

The great hall of the University of Paris was resplendent with high officials, including the French President, M. Lebrun, the Diplomatic Corps, distinguished academicians and representatives of numerous scientific and industrial organisations.

M. Mario Roustan, Minister of Education, presided, and speakers vied with each other in paying tribute to the qualities which have enabled M. Lumière to devote half a century of an active and fruitful life to promote applied science.

M. Armbruster, president of the Renaissance Française, who took the initiative in organising the celebrations, supplied a historical outline. He mentioned how Lumière, son of a photographer, of Besançon, developed with his brother a successful manufacturing photographic plant at Lyons, which became known throughout the world. He recalled the first public presentation, on December 28, 1895, of moving pictures in the basement of a Paris café, at 14 bd. des Capucines, amidst much scepticism and sarcasm—which, however, did not prevent the rapid success and growth of the enterprise.

M. Ch. Fabry, the distinguished physicist, spoke of the numerous applications of Lumière's work. M. Ch. Delac quoted figures to show the great

economic importance of the cinema industry. M. Georges Lecomte, the well-known writer, enlarged upon the aesthetic value of the cinematographic art.

Sir Robert Mond, dean of the distinguished foreign delegates present, outlined the historical development of the photography of movement, and expressed the high regard in which Louis Lumière is held throughout the world.

Historically, for the beginning of cinematography, one may go back to the animated drawings devised by the Belgian physicist Antoine Plateau in 1830, which were used in the phenakitiscope. Improved by Clerk Maxwell in 1869 and enlarged by the American, Horner, the apparatus became known as the zoetrope. Molteni, in 1850, had his choreutoscope, consisting of a glass disc on which six different positions of a moving object were drawn, so that on turning the disc the appearance of movement was produced. In 1893 Edison devised his kinetoscope, consisting of an endless film about 20 metres long, moving at such a rate that 45 images were presented per second. It had the drawback of being visible to only one person at a time.

On the photographic side, we find the American Muybridge in 1872 utilising a series of thirty cameras to photograph a galloping horse. The astronomer Janssen devised a photographic revolver in which a circular photographic plate turns round, so that 48 pictures can be taken in 62 seconds; the physiologist Jules Marey developed his chronophotograph and M. Demeny his phonoscope.

All these separate inventions and improvements do not, however, detract from the great merit of Louis Lumière, that of having devised an apparatus which will both photograph an object in motion and reproduce it afterwards upon a screen so as to give the impression of movement, in the form in which we see it to-day.

The invention of the moving picture apparatus, though the most spectacular of Lumière's inventions, forms but part of his numerous activities. In 1899 he made an apparatus for taking 'rotary' photographs, so as to be able to make a complete tour of the horizon. In 1901 he devised a 'photoramic' method of projection, and in 1907, after numerous trials, he perfected the Lumière method of colour photography still used throughout the world.

During the War, Lumière had to divert his inventive genius in other directions. He devised a method of heating the cockpit of aeroplanes, and he improved artificial limbs for mutilated soldiers. To-day, at the age of seventy-one years, we find him still active in research and invention. Recently he gave before the Academy of Sciences an exhibition of stereoscopic cinematography. At his villa at Neuilly-sur-Seine, M. Lumière has installed several laboratories that enable him to carry out his investigations in cinematography and related matters.

No account of Louis Lumière would be complete without mention of his brother Auguste, by two years his senior, who has been a constant collaborator, though specialising in the fields of chemistry and biology. The original patent for a cinema apparatus in 1895 was, in fact, taken in the joint names of Auguste and Louis Lumière, but the elder brother has made it clear that in this particular case the originator of the idea was Louis. Both brothers are members of the Paris Academy of Sciences, and have received numerous honours from scientific bodies in France and elsewhere.

Human Genetics and Human Ideals*

TWO widely held opinions on human genetics may be summarised as follows: (1) It is essential in the interests of national hygiene that the unfit should be sterilised; (2) some races are superior to others, the members of which cannot rise to the highest levels possible to humanity.

Both theories are largely based on analogical reasoning from the breeding of domestic animals. Although the laws of heredity are the same in men as in other mammals, the analogy is suspect because our domestic animals are far more genetically homogeneous than any human groups, having been established by intense inbreeding and selection. We must, therefore, examine the evidence for these propositions in detail.

Abnormalities and Sterilisation

Human abnormalities which are genetically determined fall into five main classes:

(1) Those due to autosomal dominant genes, which determine the abnormality in all cases; for example, lobster claw, cleidocranial dysostosis. Here the abnormality is handed down only by affected persons, and to about half their children, regardless of sex.

(2) Those due to autosomal genes with manifestation in some, but not all cases. For example, blue sclerotics are due to a dominant gene with 100 per cent manifestation. A fraction of the patients develop bone fragility, deafness due to otosclerosis, or both. Huntingdon's chorea, due to a dominant gene, may not develop until the age of seventy years, though the average age is thirty-five. Such abnormalities run in a family, are handed down to less than half the progeny of affected persons, and often skip a generation.

(3) Those due to sex-linked genes. These are often manifested wholly, or almost wholly, in males and transmitted by females, for example, hæmophilia. But they may be incompletely recessive in heterozygous females, and affect a proportion of them, as with Leber's disease (atrophy of the optic nerve).

(4) Those due to autosomal recessive genes. These are not hereditary in the ordinary sense. They are very rarely handed down from ancestor to offspring, but occur in one or more children of a pair, both of whom are heterozygous. They are very much more frequent in the offspring of parents who are related to one another, for example, of first cousins, than in the general population. They include amaurotic

* Substance of a Sir Halley Stewart Trust Lecture delivered by Prof. J. B. S. Haldane, F.R.S., in the Memorial Hall, Farringdon Street, London, on November 5.

idiocy, some kinds of deaf mutism, and xeroderma pigmentosum, a skin affection two thirds of the victims of which die of cancer in less than fifteen years.

(5) Those due to the co-operation of many genes. It is highly probable that many of the milder forms of mental defect are of this kind, but the analysis is still incomplete.

No far-reaching eugenical programme can be framed until we know the relative frequencies of these five classes. They are not known at present.

Sterilisation of the unfit would be very effective against type 1, moderately so against types 2 and 3, slightly so against type 5, and wholly ineffective against type 4. Here the possible eugenic measures are the discouragement of inbreeding, and the termination of marriage, or at any rate breeding, in couples who have produced one defective child. In order to deal effectively with types 2 and 3 by sterilisation, it would be necessary to sterilise large numbers of fit persons. It is doubtful whether the sterilisation of all mental defectives would reduce the number in the next generation by as much as 15 per cent.

In all cases, other measures than sterilisation are available, for example, continence and birth control for mentally normal persons, and segregation for defectives.

RACIAL COMPARISONS

When we say that race *A* is superior to race *B* in a given respect, we may mean one of five things:

(*a*) Members of race *A* have had a better chance than those of race *B* of displaying the character in question. For example, the pre-Columbian inhabitants of America were severely handicapped in their progress to civilisation by the lack of domesticable animals.

(*b*) All members of race *A* are superior to all members of race *B*. No case of this kind is known.

(*c*) No member of race *B* can possibly reach the level attained by some members of race *A*. This may be true in some cases, but is certainly not scientifically proved.

(*d*) The median performance of race *A* is superior to that of race *B*. This is probably true with reservations. Thus it is likely that, in Europe, Europeans are more socially efficient than Negroes; but the converse seems to be true in West Africa (the so-called white man's grave).

(*e*) Race *A* produces more exceptional individuals, for example, great musicians, than race *B*. This is also probably true in some cases, but as it may be due to greater variability, implies no superiority in the mass of the race.

It is emphasised that innate psychological characteristics of races overlap. Thus there is no evidence for an innate psychological characteristic found in all Negroes, but no Europeans. The so-called races of western Europe (Nordic, Alpine, Mediterranean, and so on) overlap in physical as well as psychological characteristics.

Our knowledge of the effects of human race-crossing is slight. In animals, such a cross may be advantageous in the first generation, but harmful in later generations, but there is no clear evidence as to whether this is true in man, though some facts seem to support this hypothesis.

Great caution is required in the application of our existing knowledge of human genetics, and far more extensive information is needed.

Educational Topics and Events

CAMBRIDGE.—On behalf of a body of subscribers, an offer of £540 has been made to the University to form a fund in memory of Dr. J. E. Marr, Woodwardian professor of geology. This fund is to be used to provide grants for the study of geology in the field.

The Council of the Senate recommends the approval of the plans for a new high-tension laboratory for the Cavendish Laboratory prepared by Mr. Charles Holden. The new laboratory will cost about £15,500.

OXFORD.—Henry Balfour has been granted the title of professor during his curatorship of the Pitt-Rivers Museum.

An exhibition to illustrate the work of Robert Hooke (1635–1704), in the Museum of the History of Science, will be opened by the Dean of Christ Church, on November 20, at 2.15.

The course of lectures on the scientific contributions of members of the Oxford Colleges has been continued by Dr. R. T. Gunther at New College and at All Souls. Although neither College was primarily endowed for the training of men of science, yet their early successes were remarkable. The physicians Bentley and Walter Bayley of New College, and Linacre, Warner, Bartlot, Recorde, Sydenham, Needham, Millington and Mayow of All Souls all achieved fame in various ways before a long period of quiescence in the eighteenth century. In the nineteenth century, the brothers Duncan of New College restored the Old Ashmolean as a zoological museum, while Acland of All Souls effected its removal to the new University Museum that he founded in the Parks. New College owns the house and observatory of Halley, Bradley and Bliss, and has attached to it the Savilian professorships of astronomy and geometry, which were held by Charles Pritchard, founder of the University Observatory, and H. H. Turner, who inaugurated the Seismological Department.

A COURSE of eight lectures on tropical hygiene for men and women outside the medical profession proceeding to the tropics will be given at the London School of Hygiene and Tropical Medicine, commencing on December 2. The lectures will be given by Lieut.-Colonel H. B. Newham, H. H. Clay and Sir Malcolm Watson. Further information can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

ACCORDING to the recently issued report of the Commonwealth Fund Trustees, there were 150 applications for fellowships in 1935, and thirty-one appointments were made. These comprised twenty-four ordinary fellows, two Dominion fellows and five service fellows. The fellowships are offered to British subjects, and are tenable at certain American universities for two years. The same number is being offered for 1936. Women are not eligible for appointment. Further information may be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

Science News a Century Ago

Auroral Display seen at Oxford

SOON after 8 p.m. on November 18, 1835, a vivid auroral display was witnessed near Oxford by the Rev. J. Guillemard, of St. John's College. A rapid succession of rays of light began to shoot up first in the east, and after vanishing there, appeared in nearly the same form in the west. When the display was over, a part of the sky filled with a faint silvery light diffused over a bank of clouds. (*Proceedings of the Ashmolean Society*, 9.)

The Duke of Sussex and the Royal Society

IN 1830, the Duke of Sussex accepted the presidency of the Royal Society in succession to Davies Gilbert; he held the office for eight years. On November 20, 1835, after the first autumn meeting of the Society, a correspondent, "F. R. S.", wrote to the editor of *The Times*: "On the recommencement of the annual session of the Royal Society, last night, it appeared that Mr. Lubbock had resigned his office of treasurer, for no other reason than the total want of co-operation in the objects and business of the society on the part of the Royal President, who on the alleged grounds of ill-health had not attended a single meeting of council. . . .

"Now, however, on the eve of the annual election, on St. Andrew's day, and according to the approved precedent of the last three or four years, a pathetic letter will be read to the general meeting, apologizing for past neglect, tendering a reluctant resignation, and in the hoped event of its non-acceptance, making large professions of improved conduct in the future.

"The shortness of the notice, and the utter unpreparedness of the society on the present occasion, preclude any other alternative than a sullen and indignant re-election and thus another blank session will accelerate the downward course of the society in scientific usefulness and consequent public estimation.

"It may not be too late in the course of the present session to avert so deplorable a result by some influential members taking measures for vindicating the paramount ascendency of science over rank, by making such a choice on a future election as shall atone for the original sin of not having placed a Herschell in the chair once occupied by a Newton and a Davy."

Trial of a Cornish Pumping Engine

A CENTURY ago, the pumping engines employed in the mines of Cornwall were among the finest of their kind. Quoting from the *Falmouth Packet*, the *Mechanics' Magazine* for November 21, 1835, said: "A steam-engine, lately erected on a copper mine in this neighbourhood [St. Austell], has been reported to have raised at an average rate of performance, upwards of ninety millions of pounds weight one foot high, with a bushel of coal. The correctness of this statement was questioned by rival engineers and others, and so seriously, that a challenge for a public trial was given and accepted. It took place last week, in presence of a number of most experienced mine agents from different parts of the country, and the result of twenty-four hours' trial was the unprecedented performance of lifting 125½ millions of pounds weight one foot high, with every bushel of coal consumed! The engine is of large size, the cylinder being 80 inches diameter. The principle is that of Boulton and Watt but improved in economising the heat when generated, so as in the greatest possible degree to apply it to the end of producing steam, and maintaining it until its work is performed. The engineer's name is West."

'Luminous' Appearance of *Oenothera*

DR. BUCKLAND discoursed in the Old Ashmolean Museum at Oxford on November 22, 1835, on the 'luminous' appearance of the flowers of *Oenothera*. It continued uninterruptedly for a considerable length of time; it did not appear to resemble any electric effect; and the opinion which seemed most probable was, that the plant has a power of absorbing light, and giving it out in peculiar circumstances. (*Proceedings of the Ashmolean Society*, 9.)

Societies and Academies

LONDON

Royal Society, November 7. F. W. G. WHITE and L. W. BROWN: Some measurements of the reflection coefficient of the ionosphere for wireless waves. The Breit and Tuve technique for ionospheric investigation is employed, the sender-receiver system being calibrated so that the reflection coefficient may be determined for a wave of any frequency within the range 2·80–6·50 Mc/s, from the relative amplitudes of the direct and the singly reflected atmospheric waves. Examples of measurements, made at noon during the period November 1934–May 1935, show that the total absorption suffered by the waves is very much dependent upon the critical phenomena at the transition of reflection from one region to another. The influence of the absorbing regions is estimated from the results. Estimates, based upon Appleton's theoretical formula, of the collisional frequency of the electrons with gas molecules in the F_2 ionised region of the upper atmosphere, are made. The collisional frequency is of the order 5×10^3 per second at a height of approximately 250 km. above the surface of the earth. J. P. GOTT: The electric charge collected by water-drops falling through a cloud of electrically charged particles in a vertical electric field. Measurements were made of the charge collected by a large water drop falling through a jet of the cloud containing equal numbers of positively and negatively charged cloud particles in a vertical electric field maintained between two horizontal field plates. When the upper plate was positive, the drop collected a negative charge, and when the upper plate was negative the drop collected a positive charge. This is in agreement with a theory proposed by Wilson in connexion with the mechanism of thunder-clouds. The quantitative agreement is as close as could be expected from the experimental arrangement. The experiments also afforded a test of the mechanism suggested by Elster and Geitel. If any charge was collected by the operation of this mechanism, it was too small to be observed.

PARIS

Academy of Sciences, October 14 (*C.R.*, 201, 629–692). CHARLES ACHARD, AUGUSTIN BOUTARIC and JEAN BOUCHARD: The comparative action of ordinary alkaloids and genalkaloids on the fluorescence

of uranine solutions. The genalkaloids are alkaloids in which the amino group has been converted into an amino-oxide, and, while possessing the same therapeutic actions as the original alkaloids, are less toxic. The alkaloids examined have an inhibiting effect on the fluorescence of uranine solutions, but the genalkaloids do not possess this property. The authors regard the marked attenuation of the toxic effects of the genalkaloids as due to the disappearance of their antoxygen properties. PIERRE DE VANSSAY: General bathymetric map of the oceans. CLAUDE CHEVALLEY: The theory of bodies of classes. JEAN BRAÏTZEFF: The generalisation of preceding results relating to Dirichlet series. F. MARTY: The role of the idea of the hypergroup in the study of non-Abelian groups. NICOLAS LUSIN: A new method in the theory of descriptive functions. ANDRÉ CHARRUEAU: Remark relating to a thin circular rod, articulated at its two extremities and submitted to a normal and uniform pressure. BERNARD LAFFAILLE and FLORIN VASILESCO: The *flambage* of thin cylindrical plates. S. SLIOSKINE: The question of the plane movement of heavy fluids. WILLEM UYTERHOEVEN and CORNELIS VERBURG: The effects of the periodic variation of the concentration of the neutral atoms of the vapour in a sodium lamp with alternating current. An oscillogram is reproduced showing the variation of the current, electromotive force and intensity of the yellow light. A theoretical explanation is given accounting for the observed facts. RAYMOND ZOUCKERMANN: The explosive potential of hydrogen with high-frequency current. A discussion of the effects of impurities in the hydrogen, especially mercury vapour, on the explosive potential and appearance of the discharge. FÉLIX TROMBE: The paramagnetism of metallic gadolinium above its Curie point. The ferromagnetic Curie point of gadolinium is 16° C., the paramagnetic Curie point is 29·5° C. The paramagnetic moment of the metal is 39·28 Weiss magnetons, practically identical with the moment calculated from the oxide by Cabrera, 39·25. LÉON BLOCH, EUGÈNE BLOCH and CHOONG SHIN-PIAW: The absorption spectrum of selenium dioxide. A description of a new series of absorption bands in the ultra-violet. V. KUNZL: A new method of focalisation in spectrography with X-rays. MME. THÉRÈSE GRIVET-MEYER: The absence of notable gamma emission in the collision of rapid neutrons with protons. F. BOURION and MLLE. O. HUN: The cryoscopic determination of the total hydration of the ions of sodium nitrate. M. BOBTELSKY and MLLE. R. COHEN: The conditions of formation of trivalent manganese chloride in hydrochloric acid solutions and on its decomposition in the presence of complex catalysts. RENÉ DALMON, JEAN CHÉDIN and LOUIS BRISSAUD: The nitration of cellulose by nitric anhydride. Nitrogen pentoxide in organic solution (carbon tetrachloride) is capable of nitrating cellulose to the maximum (14·1 per cent nitrogen) with a very good yield. ADOLFO T. WILLIAMS: The absorption spectra of metallic and organic colloidal solutions and the absorption of metallic films. For organic substances, the structure of the absorption spectra in colloidal solution is much the same as in true solution. EDMOND BAUER and MICHEL MAGAT: The Raman spectrum of liquid heavy water. The frequency 170–176 is nearly the same in H_2O and D_2O, but the bands 350–500 cm.$^{-1}$ and 500–700 cm.$^{-1}$ are clearly displaced towards the lower frequencies. JACQUES LEFOL: The hydrates of monocalcium silicate. RAYMOND ROHMER: The system, water – sulphuric acid – nickel sulphate. ROBERT VANDONI: The disengagement of nitrogen monoxide during the decomposition of the nitrocelluloses. The gases arising from various modes of decomposition of nitro-cellulose contain nitrous oxide in important proportions, usually higher than the proportion of free nitrogen. JULES JARROUSSE: The oxidation of diphenyl-pyruvic acid. JEAN GRARD: Cellulose triacetate. Details of method of preparation. ALEXANDRE DAUVILLIER: The determination of atmospheric ozone. A comparison of the spectrographic and chemical methods. The results by the two methods, while not identical, agree fairly well, considering that the collection of one sample is local and that the concentration of ozone near the soil may vary rapidly. PIERRE CAPPE DE BAILLON: A new strain of *Baculum artemis*. GUILLAUME VALETTE: Study of the fixation of quinine on *Paramecium* by means of the microscopical examination of the fluorescence. Cells of *Paramecium caudatum* show a maximum quinine absorption in the neighbourhood of the digestive vacuoles. EMILE CESARI, JEAN BAUCHE and PAUL BOQUET: A strain of *Vipera aspis* with white venom. GILBERT RANSON: The determinism of the seasonal fixation of *Navicula fusiformis*. Its experimental culture in ostreaculture. GASTON RAMON: The favourable effect of certain lipoid substances on the immunising action of antigens. MAURICE DOLADILHE: Contribution to the study of the globulins of the blood in relation with its alexic power. ALEXANDRE BESREDKA, ISRAËL MAGAT, PIERRE LAVAL and PIERRE BESNARD: Intra-cutaneous vaccination against Pearce-Brown epithelioma.

CAPE TOWN

Royal Society of South Africa, September 18. I. DONEN: Studies in deciduous fruit (3). The chemical changes in Kelsey and Gaviota plums during growth. The life of the Kelsey and Gaviota plum on the tree may be divided into three stages. During the first stage the growth of the stone predominates over that of the flesh. The rate of growth, and of increase of all constituents of the flesh, except alcohol-insoluble residue, is comparatively slow. The concentration of total solids, alcohol-insoluble residue and nitrogen falls rapidly during this period, but acid concentration remains high. Starch is present in the plum at the beginning of this stage only. The second stage of growth commences when the stone is fully developed. It is characterised by a rapid rise in the rate of growth of the plum and in the rate of increase of total solids, sucrose, nitrogen and acid per fruit. These rates of increase finally reach a maximum value at the end of this stage. The third stage of growth is a period of maturation. The rate of accumulation of constituents per plum falls rapidly. Sucrose and nitrogen accumulate in the flesh so long as the plum remains on the tree. D. G. HAYLETT: Studies on dropping-berry in Waltham Cross grapes (*Vitis vinifera*). J. L. B. SMITH: Some interesting new fishes from South Africa. Two noteworthy additions, one of a genus, the other of a family, new to the South African marine ichthyfauna list are described and figured. *Scymnus brevipinnis*, n.sp., is a shark from deep water off Algoa Bay. Species of this genus have hitherto been recorded only from the North Atlantic and from Japan. *Taeniolabrus marleyi*, n.sp., recently obtained at Durban, is a member of the little-known family Trichonotidæ, hitherto recorded only from the Indo-Australian region.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 17

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Reptiles".*

Monday, November 18

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—H. W. Parker: "Reptiles of the Galapagos Archipelago".*

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. Phyllis M. Tookey Kerridge: "The Physiology of Hearing" (succeeding lecture on November 25).*

UNIVERSITY OF LEEDS, at 5.15.—Dr. W. F. P. McLintock: "The Gravitational Method of Investigating Geological Structure".*

ENGINEERS' GERMAN CIRCLE, at 6.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Robert Kronfeld: "Neuzeitlicher Segelflug" (Modern Methods of Gliding and Soaring).*

ROYAL SOCIETY OF ARTS, at 8.—Dr. Bernard Smith: "Geological Aspects of Underground Water Supplies" (Cantor Lectures. Succeeding lectures on November 25 and December 2).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. G. N. Humphreys and E. Shackleton: "The Oxford University Ellesmere Land Expedition, 1934".

Tuesday, November 19

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Sir Walter Langdon-Brown: "The Integration of the Endocrine System" (Victor Horsley Memorial Lecture).*

EUGENICS SOCIETY, at 5.15.—(in the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—J. V. Quilliam, Mrs. C. B. S. Hodson and Dr. C. P. Blacker: "Voluntary Sterilisation—The Work of the last Two Years".*

CHADWICK PUBLIC LECTURE, at 5.30.—(at the London School of Hygiene, Keppel Street, W.C.1).—Prof. R. C. McLean: "The Bacteriology of the Atmosphere".*

BRITISH PSYCHOLOGICAL SOCIETY, at 6.—Dr. J. N. Langdon: "Monotony and Industry".

UNIVERSITY OF LEEDS, at 8.—(in the Philosophical Hall, Park Row, Leeds).—R. A. Watson Watt: "The Weather House".

Wednesday, November 20

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, Ivan D. Margary and C. J. P. Cave: "Report on the Phenological Observations in the British Isles, December 1933 to November 1934".

Thursday, November 21

ROYAL SOCIETY, at 4.30.—A. R. Ubbelohde, J. W. Drinkwater and A. Egerton: "'Proknocks' and Hydrocarbon Combustion".

D. T. A. Townend and E. A. C. Chamberlain: "The Influence of Pressure on the Spontaneous Ignition of Inflammable Gas-Air Mixtures. (4) Methane, Ethane, and Propane—Air Mixtures".

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, London, E.C.).—Prof. Julian Huxley.*

CHEMICAL SOCIETY, at 8.—Discussion on "Some Aspects of the Interaction between Gases and Solids", to be opened by Prof. E. K. Rideal, followed by Dr. J. K. Roberts and Dr. R. M. Barrer. Other speakers: Prof. A. J. Allmand, Dr. R. C. L. Bosworth, Dr. A. Farkas, Prof. W. E. Garner, Prof. J. E. Lennard-Jones and Dr. H. W. Melville.

ROYAL SOCIETY OF MEDICINE (NEUROLOGY SECTION), at 8.30.—Prof. E. D. Adrian: "Electrical Activity of the Cortex".

Dr. J. H. Quastel: "Enzymic Activity of the Brain".

Friday, November 22

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30.—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—H. A. Tripp: "The Problem of Road Casualties".*

INSTITUTE OF FUEL, at 6.—(at the Institution of Electrical Engineers).—Kenneth Gordon: "Development of Coal Hydrogenation by the I.C.I., Ltd."*

ROYAL INSTITUTION, at 9.—Prof. John Read: "A Musical Alchemist".

Saturday, November 23

ROYAL INSTITUTION, at 3.—Dr. Lawrence Binyon: "Chinese Painting" (succeeding lecture on November 30).

Official Publications Received

Great Britain and Ireland

New Forest Association. Annual Report and Statement of Accounts, 1935. Pp. 19+4 plates. (Brockenhurst. Capt. C. Sutton, Hon. Sec., Estate Offices.) [2510

Department of Scientific and Industrial Research. Report of the Forest Products Research Board with the Report of the Director of Forest Products Research for the Year 1934. Pp. vi+75+2 plates. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [2610

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1660 (Spin. 206): Slots and Interceptors in Spins. By S. B. Gates, H. B. Irving, R. P. Alston and A. V. Stephens. Pp. 29+20 plates. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [2910

Agricultural Research Council. A Report by a Committee on the Preservation of Grass and other Fodder Crops. (A.R.C. Report Series, No. 1.) Pp. iii+35. (London: H.M. Stationery Office.) 1*s.* net. [3010

Proceedings of the Royal Irish Academy. Vol. 42, Section B, No. 15: The Metamorphic Rocks of Inishowen, Co. Donegal. By Dr. William J. McCallien. Pp. 407–442+plates 6–11. 2*s.* Vol. 42, Section B, No. 16: Larval Stages of the Euphausids *Nematoscelis megalops* (G. O. Sars) and *Stylocheiron longicorne* (G. O. Sars) taken off the South-west Coast of Ireland. By Winifred E. Frost. Pp. 443–458+plates 12–15. 1*s.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [3110

Battersea Polytechnic. Report of the Principal for the Session 1934–35. Pp. 39. (London: Battersea Polytechnic.) [3110

Medical Research Council. Special Report Series, No. 204: Medical Uses of Radium; Summary of Reports from Research Centres for 1934. Pp. 45+2 plates. (London: H.M. Stationery Office.) 1*s.* net. [3110

Other Countries

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 128: JS-Diagrams for Combustion Gases of Correct and Weak Mixtures. By Keikichi Tanaka and Seichi Awano. Pp. 283–297+15 plates. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 2.05 yen. [2810

Colony and Protectorate of Nigeria. Annual Report on the Geological Survey Department for the Year 1934. Pp. ii+36+7 plates. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 3*s.* 6*d* net. [2910

New Zealand. State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1935. Pp. 19. 9*d.* Leaflet No. 26: The Properties and Uses of Kauri (*Agathis australis*). By Alex R. Entrican. Pp. 14. (Wellington. Government Printer.) [2910

Western Australia. Report of the Royal Commission appointed to Investigate, Report and Advise upon matters in relation to the Condition and Treatment of Aborigines. Pp. 24+3 plates. (Perth: Government Printer.) [3110

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102: Mededeelingen en Verhandelingen, No. 36: Het Klimaat van Nederlandsch West-Indie. Door Dr. C. Braak. Pp. 120. ('s-Gravenhage: Rijksuitgeverij.) 1.00 f. [111

Department of Mines: National Museum of Canada. Bulletin No. 74 (Biological Series, No. 20): Botanical Investigations in Wood Buffalo Park. By Hugh M. Raup. Pp. iii+174. 50 cents. Bulletin No. 75 (Anthropological Series, No. 16): Folk-Songs of Old Quebec. By Marius Barbeau. Song translations by Regina Lenore Shoolman. Pp. iii+72. 25 cents. (Ottawa. King's Printer.) [111

Canada: Department of Mines: Bureau of Economic Geology: Geological Survey. Memoir 176: Geology of Southern Saskatchewan. By F. J. Fraser, F. H. McLearn, L. S. Russell, P. S. Warren and R. T. D. Wickenden. (No. 2373.) Pp. ii+137+5 plates. 50 cents. Memoir 179: Lode Gold Deposits of Fairview Camp, Camp McKinney and Vidette Lake Area, and the Dividend-Lakeview Property near Osoyoos, B.C. By W. E. Cockfield. (No. 2392.) Pp. ii+38. 25 cents. Memoir 181: Barkerville Gold Belt, Cariboo District, British Columbia. By G. Hanson. (No. 2396.) Pp. ii+42. 25 cents. (Ottawa: King's Printer.) [111

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3447 SATURDAY, NOVEMBER 23, 1935 Vol. 136

Economics of Plenty*

FEW problems have astonished the modern world so much as the apparent paradox of "poverty in the midst of plenty" yet, as Sir Josiah Stamp pointed out in his Norman Lockyer Lecture to the British Science Guild, delivered on November 13 and entitled "The Calculus of Plenty", the problem is by no means new, for just a hundred years ago, Carlyle could write that "In the midst of plethoric plenty, the people perish". As the years have gone on, the term 'plenty', while still covering the glaring maladjustment of things made, longed for but unused, has gradually widened in content to mean much more. In the last few years, it has become so nebulous and over-suggestive as to be, in Sir Josiah Stamp's words, almost an intellectual menace. The conception for which it stands, however, is in all conscience, he said, serious enough, though we should not be overawed or confused by it. The rigorous analytical examination to which Sir Josiah subjected the term 'plenty' in the course of his lecture provides an important contribution to the elucidation of the various problems involved, which only too often are lumped together to the confusion of clear thinking. Adopting a main threefold classification with various sub-heads, he classified 'plenty' as first that of physical or scientific potentiality; secondly, as that of unused or unmarketed production; and thirdly, that of unused capacity.

The plenty of potentiality is mainly a conception of the engineer and man of science, and it was developed to its greatest extent by the exponents of technocracy, who have left a sinister trail of dreams and pseudo-statistics over the whole field of thought and inquiry. Generally speaking, it expresses the facts of output in terms of reduced man-power for a given output. But the crude figures of engineering potentiality need to be qualified before the net figures of economic potentiality are deduced. It may well be that on the manufacturing side all the attendant supplies and processes cannot be speeded up to correspond, or the full and even load postulated may not really be available. Further, even supposing a considerably lower price is possible for the larger quantities available, after allowing for every production difficulty, it is not certain that the amount will be taken by the public at that price or even at any price. It might be a boon to make 100 fire grates with the ease with which one is now made, and yet not really a greater boon in any realistic sense to make 1,000 for every one now. Technical possibility has to be considered against a background of economic and psychological relativity. A further serious limitation will arise if in fact there are only one or two of the new machines in existence, and the bulk of supply comes from older equipment. In this event, the alleged plenty does not actually exist, nor is it actually potential; it is only hypothetically or ultimately potential.

The current concept of plenty popularly linked in almost causative association with poverty is fed from three main sources: the concept of things not hitherto made but now capable of being made, the concept of things already made and standing unused, and the concept of things that have not but could have been made.

Large dynamic ideas are scientifically dangerous if they remain unmeasured. Technological and scientific conceptions of plenty are capable of measurement and quantitative statement, but an accepted technique for this purpose is still lacking,

* The Calculus of Plenty. By Sir Josiah Stamp. (The Norman Lockyer Lecture, 1935.) Pp. 35. (London: British Science Guild, 1935.) 1s.

and no recognised units of productivity have yet been devised which are capable of being fairly aggregated and compared. The problem, however, goes much further than the mere measurement of plenty, since successive increments of productivity of apparent equality in measurement may have different values in practice. It may be, for example, that an invention can only be brought into full use gradually; fuller utilisation of unused capacity may involve greater proportionate expense for each unit, or increased supplies may only be demanded if the price is reduced.

The technocrats made grossly excessive claims about the potentialities of science and invention, nearly always stated quantitatively, and with great apparent exactness, thus conveying an impression of realisable plenty were it not for someone's stupidity or the faults of society. Some of the processes of technocratic computation, it would seem, assumed that machinery would be kept working 24 hours a day, or that what was true for an isolated process was true for a whole industry.

The gross possible theoretical or technical capacity based on engineering ideas has to be brought down to the more important economic capacity in several stages. First there is the operating margin. A 100 per cent use is in practice unattainable; a part amounting to something like 20 per cent must serve as a reserve for breakdown, repairs, irregularity of supplies, etc.

Secondly, there is unco-ordinated surplus capacity, since industries are not so perfectly integrated as to make possible a flow of production which will keep all stages fully employed. An intensified demand may quickly bring out some limiting factor. Allied to this, there is seasonal surplus capacity, and plant cannot be deemed to have a yearly capacity equal to its seasonal capacity multiplied by the full term.

Thirdly, it is possible that two industries may have surplus capacity technically equal yet vastly different in practical potentiality. For example, people might be desiring radio sets more and more and pianos less and less, and not generally both. Abundant purchasing power means much greater demand for the one, very slight extra demand for the other. Clearly potential 'plenty' cannot be regarded as the aggregate of these two unused sets of plant. Further, the advance of science and invention may render certain productive units obsolescent, or capital may be invested in production which is economically misplaced.

Consideration must also be given to the demand side. Suppose there is an efficient up-to-date plant for the production of a certain article which is only 70 per cent utilised, but which could be fully utilised without difficulty. Then we could only call the 30 per cent "plenty in the midst of poverty" if additional employment or spending power enhances total demand at the former price, so that an enhanced total supply produced at the same cost is marketed. But if increased spending power gives a relatively less increased demand for this article and the increased supply is at a relatively higher cost, we certainly could not.

The destruction of actually produced wealth when men are in need strikes the imagination much more than mere unused capacity; it seems so wanton. But this, as Sir Josiah Stamp pointed out, is by no means entirely a modern phenomenon, for the throwing overboard of Eastern produce to maintain the price of the remainder has in a former century been the producers' strike against an elastic demand schedule.

Stocks 'carried over' have not all the same quality. A glut of plums in Worcestershire not worth the cost of picking and getting to market is not effectively 'plenty', though if there is a canning factory then it may well be plenty. Here, of course, the demand schedule for canned fruit is quite another thing than that for fresh fruit. Then there is obviously a 'quality of position', for a surplus of tons of produce in Australia can well be different from tons in Smithfield. Perhaps the best-known example of the actual destruction of 'plenty' is the recent burning of coffee in Brazil, but not everybody has realised that the probable cause of the whole episode was an attempt on the part of producers, not merely to maintain prices but even to raise them. The excess supply of wheat of late years seems enormous when stated absolutely in bushels, but if it is measured in relation to total consumption, namely, 2·05 per cent, it becomes quite reasonable.

Sir Josiah Stamp also discussed the measurement of invention 'plenty'. Often innovations take a long time to get fully adopted if their margin of advantage is not revolutionary. The laboratory case may be proved up to the hilt, the engineer may be positive but the capital market is slow in moving; and, in Sir Josiah's view, there is no reason to suppose that socially-owned capital would be more progressive and risk-taking than privately-subscribed capital, so as to reduce the lag between an idea and its practical development.

Woman: Past and Present

Woman: an Historical, Gynaecological and Anthropological Compendium
By Hermann Heinrich Ploss, Max Bartels and Paul Bartels. Edited by Eric John Dingwall. Vol. 1. Pp. xiii + 655. Vol. 2. Pp. xii + 822. Vol. 3. Pp. viii + 543. (London: William Heinemann (Medical Books), Ltd., 1935.) 3 vols., £8 8*s*. 0*d*. net.

FOR fifty years the various editions of "Das Weib" have had a considerable reputation on the Continent, in Great Britain and in the United States. The later editors revised and enlarged the book originally written by Dr. H. H. Ploss and added numerous new illustrations, and it has thus become a unique compilation on womankind. Hitherto there has been no English translation, but now English students can study with ease the accumulated data of the eleventh edition. This work, however, is not a mere translation, as the English editor, Dr. E. J. Dingwall, has made corrections and added supplementary matter, thus bringing it up to date so far as was possible. This laborious task has been performed in a most praiseworthy manner, and we have also to thank him for the very extensive bibliography. A noticeable feature of the work is the excellence of the illustrations, which are more than a thousand in number, but some of them could easily have been dispensed with Loaded paper is used throughout on account of the illustrations and this makes the volumes uncomfortably heavy to hold; vol. 2 weighs nearly 6 lb.

This is a really remarkable compendium of the very voluminous literature that deals directly or incidentally with what appertains to women. The information is culled from ancient and modern authors and from the records of travellers and trained investigators among innumerable backward peoples as well as among the backward elements in modern communities. The external and internal anatomy of women is described and illustrated in detail, and sufficient physiological information is given for those who are not physiologists. Matters of interest are provided for those who occupy themselves in the history of medicine and obstetrics; but it is to anthropologists especially that the work will be of value, as it places at their disposal a wealth of material which otherwise it would be impossible for them to acquire. But it is to be feared that the great cost of the work will prevent most anthropologists from procuring it.

The exigencies of space precluded that any one section of the social aspects of womankind could be treated in anything like a complete manner. Probably enough has been given to satisfy ordinary requirements, but many recent field-workers will look in vain for the facts and inferences which are familiar to them. The ethnologist has much provided for him, but he will have to search elsewhere for further details and for other explanations of the significance of what is recorded.

The lengthiest discussion of social practices and institutions is that on the development of the institution of marriage. To the authors, man appears from the very beginning as a gregarious animal, and according to them it is really absurd to assume a monogamous institution in mankind. They go so far as to say that every form of 'marriage' conceivable among human beings occurs among animals and that all of them are dependent upon the care of the offspring. This is not the occasion to add to the unnumbered discussions of the origin of marriage or (as the authors hold) the priority of matriarchy to patriarchy and similar topics. Many modern ethnologists regard these subjects from a different point of view, or look upon them as being unprofitable to discuss

The authors have very little to say concerning certain social and legal aspects of the position of women in a community. Much has been written, for example, about men's dread of contamination from women and about the various methods adopted to prevent or nullify it. This attitude certainly exists, but it is also well recognised that a man pays very little attention to restriction when he desires a woman. Individuals frequently break away from the standardised pattern of behaviour in regard to social barriers to marriage, forbidden degrees of relationship and the like. Irregular marriages are so frequent in some communities that there is a definite mechanism for socialising them, as it is recognised that strict adherence to custom is impossible in certain circumstances and it is necessary to regularise and establish the position of the children in society—which is one of the main functions of marriage. Common-sense usually prevails in primitive communities in a conflict between theoretical morality and what actually takes place.

Further, certain social practices in connexion with young women are best understood if those persons are regarded as property—more especially corresponding to property in trees. An essential idea of property is work done, and in many places a man who plants a fruit tree owns it and its

usufruct in perpetuity irrespective of who happens to own the land on which it is planted. The parents of a girl have had to do work in rearing her; when she marries, this work is usually recognised in payment by the groom or his group, or by the groom working for her parents. The loss of a woman to a group is also the loss of her prospective children; thus the groom may have to pay for the rearing of the girl and also for her usufruct, and these payments may extend over a number of years. This conception of property applies to the rape of an unmarried girl, which is described as a theft from the father or guardian, and that of a married woman from her husband. The transference of ownership is ratified not only to the husband or to his group by gifts, such as *lobola*, or whatever term may be used for this transaction, but also by bodily markings, a ring, adornment or other means. The recognition of ownership is in rare cases enforced by a chastity belt. The idea of property is, however, only one of the sentiments connected with marriage.

The method adopted in this work is of great value for those interested in comparisons and distributions, but it necessarily precludes any precise or even general conceptions concerning the place of woman in the life of communities. Woman is cut out of the picture. Those who desire to learn how women's activities and emotions are related to the functioning of particular communities must consult such books as "The Sexual Life of Savages in North-Western Melanesia" by B. Malinowski, who deals in a very thorough way with the Trobriand Islanders of Papua, and in "The Sorcerers of Dobu" by R. F. Fortune, who shows in another Papuan island the working of a society in which the wife and her village dominate the husband, who is always an alien. Dr. Margaret Mead illustrates the functioning of the very unpleasant family life of the people of Manus, Admiralty Islands, in her wrongly entitled book "Growing up in New Guinea", and in her "Coming of Age in Samoa" she gives a picture of a very different kind of family life. It is not fair to criticise authors for not doing what is outside the limits they have set themselves, but within these limits they have produced a work of great value.

A. C. HADDON.

Insect Morphology

Principles of Insect Morphology

By R. E. Snodgrass. (McGraw-Hill Publications in the Zoological Sciences.) Pp. ix+667. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 36*s*. net.

THE author of this book ranks as the foremost American worker on insect morphology. His contributions on the subject are notable for their clarity and originality of thought, and the appearance of a volume, embodying his ideas in comprehensive form, is sure of a hearty welcome. In its preparation, Mr. Snodgrass has incorporated the results of much first-hand study with those of many recent investigators in the same field. He has produced an outstanding book wherein knowledge of facts is combined with that of function and, at the same time, theoretical conceptions of the origins and relationships of organs and parts are not overlooked.

The book is divided into nineteen chapters, each concluding with a glossary of the special terms used: the definitions are exact, and should help to eliminate prevailing ambiguities of terminology. The general subject of morphology is opened with a short chapter on arthropod organisation as a background, while the fundamentals of insect structure are reviewed from the development point of view. The body-wall and its derivatives are dealt with at length, and a clear exposition of the physico-chemical properties of chitin is included. The subject of sclerites and segmentation forms another chapter, which is followed by one on the general morphology of arthropod limbs. In this connexion, the author follows Störmer (1933) in rejecting the view that trilobite limbs are truly biramous, the so-called exopodite being interpreted as an epipodite. Mr. Snodgrass stresses the fact that 'biramous' limbs are peculiar to Crustacea, and that there is also no sound evidence of their occurrence in any Tracheata. In the chapters dealing with the structure of different body-regions, and their appendages, lucid explanations of their morphology are given, while the usually neglected subject of myology comes in for adequate treatment. The application of this latter aspect to the interpretation of the labium has clarified the prevailing inaccuracies of nomenclature.

The chapter on wings and flight is of special interest in that the author expresses original views on the anal group of veins and on the relations of the chief veins to the articular sclerites: the subject of wing regions also comes in for special discussion.

Under the title of 'Organs of Ingestion', the mouth-parts of individual orders and their larvæ are described at length, together with their musculature and methods of functioning. The various internal organs and systems are discussed in separate chapters.

In dealing with the nervous system, the author takes due account of the extensive work of Hanström in regarding the proto- and deuto-cerebral ganglia of the brain as secondary differentiations of an original prostomial archicerebrum, the tritocerebrum being interpreted as the first ganglionic centre of the ventral nerve cord. The histology of the nerve centres is very fully treated in the light of recent neurological research. In coming to the sense organs, the account, although adequate in most respects, says little of the tympanal organs of Lepidoptera, and no mention seems to be made of the halteres of Diptera or of the modern conception of general stimulation organs.

The final chapter on the genitalia is a full and well-illustrated treatment of a complex subject. The book concludes with twenty-two pages of up-to-date bibliography. In a short notice little more than an indication of the scope of this work is possible, but it remains to be emphasised that it is a really sound scientific treatise of first-rate importance, which no worker on the subject can afford to neglect. A. D. IMMS.

A Poet's Picture of Life and Philosophy

The Mystery of the Mahābhārata

By N. V. Thadani. Vol. 1: A Vision of the Vedas. Pp. lxiv+432. 12 rupees. Vol. 2: The Systems of Hindu Philosophy and Religion. Pp. xviii+371. 8 rupees. Vol. 3: The Story and the Essence of the Epic. Pp. lii+462. 8 rupees. Vol. 4: The Explanation of the Epic, Part 1. Pp. xlvii+378. 8 rupees. Vol. 5: The Explanation of the Epic, Part 2. Pp. xvi+379–924. 8 rupees. (Karachi: Bharat Publishing House, 1931–1935.) £4 the set.

IT may not be unknown to most readers that the Mahābhārata, or Great Bharatiana (that is, things about the Bharat clan, as the title is usually understood), is to Indian literature what the Iliad is to that of Greece, only immensely longer, the long period of its compilation being of equally indefinite date. The only portion of it with which they are likely to have any direct acquaintance is the episode known as the Bhagavadgītā, or Song of the Blessed One, best known to us in the translations of Edwin Arnold, Dr. L. Barnett and that in the sacred books of the East.

Mr. Thadani, late principal of the Hindu College, and rector of the University of Delhi, agrees with Indologists in seeing in the vast work, of which tradition holds that only a summary—and that being 100,000 lines!—has survived, the hand of many writers (possibly, before that, the voice of many Sayers). But he does not concede that the many are a succession of editors, incorporating new values, altering, dropping out superseded values. He is before all a poet, and has a vision of "a great school of thought which seems to have flourished in India in the past". He does admit that his 'school' will have included results of new knowledge from time to time. But he claims that from first to last the epic has 'unity of design', and that this design was to give a "picture of all systems of philosophy and religion in story-form", and incidentally "an account of the universal history of Man or the human race".

Enough said—at least for present limits of space. I do not recommend the study of these volumes to scholars; they are too poor in first-hand knowledge and in historic perspective for such. Nor to the serious inquirer at second-hand, and for the same reasons. The account given, among the 'systems', of Buddhism, shows these weaknesses perhaps at their worst—or is it because there I am better able to judge? But for the literary reader and for the student of racial types in authors, it may prove an interesting (and in style very readable) mine of curious information. Especially perhaps where the venerable cosmic 'egg', as the primary unit of life at the creation, appears in modern dress as 'the cell', and in the theory of Sanskrit as having been deliberately constructed "as a picture of Brahm'anda, that divine egg". A poet runs the great danger of seeing his perspective just like that: "as a picture", and often an ancient picture at that. I mean one in which the time-quality is either represented merely as background, or all as in the foreground. A book which can set out to give a picture of the history of man, by way of 'systems' of religion and philosophy, without any mention in its index—and it is one of forty pages!—of man's will and man's becoming, can scarcely contain even the rudiments of that history, of that real nature.

C. A. F. RHYS DAVIDS.

A Neglected Aspect of the Calculus of Variations

Variationsrechnung und partielle Differentialgleichungen erster Ordnung
Von Prof. Constantin Carathéodory. Pp. xi + 407. (Leipzig und Berlin: B. G. Teubner, 1935.) 22 gold marks.

THE work of Euler and Lagrange in the middle of the eighteenth century proved that the essence of theoretical mechanics lay in the calculus of variations, which was itself something that included not only all mechanics but also much else besides. Mechanics is a class of partial differential equations; the calculus of variations corresponds to a similar but bigger class, whose essential properties differ only in detail from those of the former class. Jacobi in particular stressed, in 1836, the intimate relation that subsists between systems of partial differential equations of the first order and equations arising out of the calculus of variations.

There for the next forty years the matter rested; no doubt for lack of some of those essential principles which were in that period changing from fluidity to solidity, there is small evidence of development in the direction to which Jacobi's researches seemed to point. Then in 1879 appeared the work of Weierstrass, which gave the calculus of variations its independence from its first parent, mechanics, an independence which it maintained only until it was adopted by the new and comprehensive calculus of functionals.

From the time of Weierstrass the evolution of the general theory of the calculus of variations proceeded in directions which appeared to loosen the primal association with partial differential equations, an association which, though noticed in a casual manner from time to time, all but disappeared from sight. Thus those landmarks of the period, the textbooks of Bolza (1909) and Hadamard (1910), tend away from, rather than towards, the Jacobian point of view (though Hadamard clearly realised that there was still much to be revealed), whereas the more recent and more highly specialised books—that of Morse (1934) may be quoted as a distinguished example—pass still further away.

In his preface to the book now before us, Carathéodory tells how he has been endeavouring for many years to pick up the threads of the connexion between the calculus of variations and partial differential equations left by Jacobi and his pupils. The old-fashioned theories of partial differential equations proved inadequate for this purpose because they were evolved with the view of forcing the equation to disgorge a solution—or at least the skeleton of one—and were often in the nature of artifices the scope of which was limited and power unreliable. That moderately complete knowledge of the essential nature of a solution which has now been gained, together with the modern weapons of mathematics, such as the tensor calculus, provide an equipment both necessary and effective for weaving new matter into the older fabric.

In order that an adequate account of the theory of partial differential equations, refined and recast in moulds of precision, should be always at hand, the author has devoted the first ten chapters (163 pages) of his book to developing this theory. With as great a generality as is possible without making the existence theorems somewhat repulsive, yet at the same time without imposing tiresome restrictions on the work he is leading up to, the author establishes the basic theory of characteristics, canonical transformations of systems of equations, contact transformations and the Pfaff problem. Though it was designed as a necessary preliminary to the second half of the book, and indeed serves that end to perfection, it is actually an account remarkable in itself for lucidity and completeness.

Apart from an introductory chapter on maxima and minima in the ordinary sense, the second part of the book is devoted to founding the theory of the calculus of variations on the basis that has been mentioned. But though the basic association with partial differential equations is emphasised throughout, the link is not stressed to breaking point. Except in the examples by which the author illuminates the theory and puts its powers to the test, everything is stated in terms of many-dimensional space. Incidentally, the examples—they have an index of thirty entries to themselves—are extraordinarily interesting, and made all the more valuable by some clear and striking diagrams. Naturally the limits of space imposed upon the author have restricted the scope of the work, excluding discontinuous solutions and other topics to which the contributions of Carathéodory himself have been considerable. But the essence is there—in places perhaps a little concentrated, but never turbid. In brief, the author treats of the simple and the parametric variation problems, the second variation, the boundary problem, closed extremals and the Lagrange problem. An extensive bibliography is accompanied by ample indications to sources of information about those topics which are not contained in the text. In sum, this book is indispensable. E. L. I.

Die wichtigsten Lagerstätten der "Nicht-Erze"
Von Prof. Dr. O. Stutzer. Band 6: Die Lagerstatten der Edelsteine und Schmucksteine. Von Prof. Dr. O. Stutzer und Dr. W. Fr. Eppler. Pp. xvii+567. (Berlin: Gebrüder Borntraeger, 1935.) 43.50 gold marks.

IN this book, the first section, which is an enlarged and rewritten version of an earlier work by Dr. Stutzer, gives an interesting account of the diamond fields of the world, plentifully illustrated with maps, diagrams and photographs. Statistical tables are given, and these emphasise the enormous extent of the diamond industry, accounting for more than 90 per cent of the world's trade in precious stones. In 1929, the total production reached nearly eight million carats, more than half of which came from pipes and gravels in the Union of South Africa.

The second and slightly larger section, written by Dr. Eppler, is entirely new, and provides a useful survey of all the more important sources of the precious and semi-precious stones, arranged according to their chemical composition. The section concludes with a long chapter on amber (much in favour in Germany just now) and a note on jet. The treatment of each species consists of a brief summary of its chief mineralogical characters, followed by a description of the geology of the most important deposits, and a note on the commercial aspect of its production. Pyrites, which is extensively used in cheap jewellery as 'marcasite', receives no mention, nor do sphene, andalusite, or phenakite—while on the other hand, such rarities as benitoite and euclase are included in this section.

Although not free from minor errors, omissions and misprints, the book can be recommended as a most useful monograph on the subject. B. W. A.

Hydrographie
Von Prof. Dr. Friedrich Schaffernak. Pp. ix+438. (Wien und Berlin: Julius Springer, 1935.) 46.50 gold marks.

PROF. SCHAFFERNAK, from the store of his knowledge and experience as an exponent of the principles of hydrography at the Technical High School of Vienna, has compiled a textbook on the subject which should be extremely useful to students, as also to others who are engaged in observational and experimental work of this nature. The volume is divided into three main parts, the first of which deals with the taking and assembling of hydrographical, meteorological and morphological observations, including rainfall, water-levels and discharges of rivers and streams; the second with statistics in an analytical and graphical form; and the third with a consideration of important special problems and their solution.

There is a fully illustrated description of the various instruments and appliances which are used in connexion with the field work of hydrology, and a variety of information concerning the taking and classification of readings; while the mathematical side also receives attention. The illustrations and diagrams are clear and easily intelligible, and there is a serviceable index. B. C.

Head, Heart and Hands in Human Evolution
By Dr. R. R. Marett. Pp. 303. (London: Hutchinson and Co. (Publishers), Ltd., 1935.) 10*s*. 6*d*. net.

IN this volume Dr. Marett has brought together a number of addresses, lectures and essays, ranging from three presidential addresses to the Sociological Institute in 1933–35, and the Donellan Lecture delivered at Trinity College, Dublin, in 1933, to a number of miscellaneous papers, including contributions to publications of a popular or semi-popular character. Notwithstanding their varied character and purpose, they have a certain unity, which is suggested by the author's choice of a title. Between them all they cover the sum of human activities, through which man expresses himself as a member of a society, as a being in relation to a spiritual world, and as an exploiter of his material environment, whether for the practical needs of everyday life or for the expression of an æsthetic impulse.

Dr. Marett is an evolutionist in so far as that term is applicable to the consideration of man's cultural development; but he is too expert in handling philosophical categories to allow himself to be entrapped into the crudities which are attributed, not always justly, to that school. In the first of his addresses to the Sociological Institute he is careful to expound the distinction which is to be drawn between the implications of the biological terms 'evolution' and 'progress' in cultural development. On the other hand, he shows that the evolutionary position in anthropology conforms to the requirements of the biological concept in that, rightly understood, it neither postulates, nor claims to find in the evidence, the unilateral progression which is said to be its characteristic defect.

Civilisation and the Growth of Law:
a Study of the Relations between Men's Ideas about the Universe and the Institutions of Law and Government. By Dr. William A. Robson. Pp. xv+354. (London: Macmillan and Co., Ltd., 1935.) 12*s*. 6*d*. net.

DR. ROBSON traces the growth of 'law' from its origin as an observed order in early societies and as conformity to the will of a ruler, divine, or of divine quality, to that of modern times, in which natural law as the ordered process of natural phenomena stood over against human law, which enforced obedience to a rule of conduct to be observed in any given community. He shows how the institutions of government have been influenced successively by magic, superstition, religion and science. The modern scientific outlook, however, he holds, has produced a profound modification in the conception of the character of natural laws as based upon objective reality. Hence he seeks to show that the gap between natural law and human law may now be bridged in a synthesis —the human mind, which formulates them—in other words, in the creative powers of the human intellect. Dr. Robson has written a stimulating book, which prompts a re-examination of certain fundamental sociological and juristic conceptions in the same way as it is now necessary in the light of modern theory to examine fundamental concepts of natural science.

Heavier-than-Air Aircraft:
a Brief Outline of the History and Development of Mechanical Flight with reference to the National Aeronautical Collection, and a Catalogue of the Exhibits. By M. J. B. Davy. (Board of Education, Science Museum: Handbook of the Collections illustrating Aeronautics, 1.) Second edition (revised and enlarged). Pp. 125+26 plates. (London: H.M. Stationery Office, 1935.) 2*s*. 6*d*. net.

THE second edition of this handbook contains an outline of the history and development of mechanical flight from the beginning to the present day, with special reference to the National Aeronautical Collection, and a complete catalogue of the exhibits at South Kensington.

The National Aeronautical Collection, which was founded as a historical exhibit in 1919, has enlarged rapidly since that date, and is now probably the most comprehensive exhibition of its sort in the world, and one of the most popular of the collections at the Science Museum. Much original historic apparatus has been acquired, and the collection is certainly richer in this respect than any abroad. It includes the gliders of Lilienthal, Pilcher, Chanute and Weiss; the original Wright aeroplane which made the first flights in 1903, the Vickers-Vimy aeroplane which made the first crossing of the Atlantic by air in 1919, the Supermarine Rolls-Royce Seaplane S.6.B., which secured the Schneider Trophy for Great Britain and created a world speed record of 407·5 miles an hour. A note on the development of air transport to the year 1934 is included in this edition, and some new illustrations have been added. The catalogue portion includes the additions to the Collection which have been made since 1929.

The Chemical Formulary:
a Condensed Collection of Valuable, Timely, Practical Formulæ for making Thousands of Products in all Fields of Industry. Editor-in-Chief: H. Bennett. Vol. 1. Pp. x+604. Vol. 2. Pp. ix+570. (London: Chapman and Hall, Ltd., 1933–1935.) 25*s*. net each vol.

THESE two volumes consist of numerous receipts for the manufacture of a wide range of materials dealt with under such varying headings as adhesives, alloys and metals, food products, explosives, ceramics, insecticides, plastic materials, etc., to waterproofing of materials. The information used in compiling these books has been obtained from a variety of sources, including industry and patent literature, and has been carefully considered by a board of editors drawn from a large number of educational institutions and industrial firms.

Although correct quantities may be used, much depends upon the method of compounding and other factors if the best results are to be obtained, and so experimental work or consultation with other workers in a similar field may be necessary. Nevertheless, the contents of these volumes supply much useful information on how various products can be obtained, and are therefore very suitable works of reference to both the educationist and the industrialist.

Wasserbauliche Strömungslehre
Von Dr. Paul Neményi. Pp. viii+275. (Leipzig: Johann Ambrosius Barth, 1933.) 28 gold marks.

DURING the past twenty years, a complete change of outlook has occurred in all subjects involving the mechanics of fluid motion. In the main, this is due to intensive aeronautical research originating in the War period. Almost without exception, writers of textbooks of hydraulics have ignored this advance and have merely rearranged and expanded the older material. Dr. Neményi, on the contrary, almost creates a new subject. The scope and arrangement are new, and much of the subject matter is ably abstracted from recent original papers.

Written primarily for the civil engineer, or perhaps rather for the advanced student, it is for the most part an exposition of the fundamental principles of flow, classified under a variety of boundary conditions. Mathematical treatment is occasionally used, but only where the matter really warrants it. Ample references, however, are given to the original papers where the full treatments can be found.

Some idea of the scope may be given by the following random selection from chapter headings: river-bed and silt movements, ice in relation to the river problem, underground water, jets and sprays, the layout of a laboratory for hydraulic model testing. All are fully illustrated by photographs, curves and line diagrams.

As this work is likely to have far-reaching influence, it is to be hoped that the author will be able to arrange for an English translation.

Hand- und Jahrbuch der chemischen Physik
Herausgegeben von A. Eucken und K. L. Wolf. Band 6: Elektrizitat und Materie. Abschnitt 1B: Dielektrische Polarisation. Von O. Fuchs und K. L. Wolf. Pp. x+237–460+12. (Leipzig: Akademische Verlagsbuchhandlung G.m.b.H., 1935.) 27 gold marks.

THE subject of "Dielectric Polarisation" acquired a new interest and importance, to chemists as well as to physicists, when Debye in 1912 showed how the dipole moment of a gas could be deduced from the temperature coefficient of the dielectric constant, and J. J. Thomson in 1914 showed how, either by this method or by comparing the dielectric constant with the square of the refractive index, gases could be divided into two classes, according as their molecules do or do not possess a permanent dipole moment. Subsequent years have been marked by intense activity in correlating dipole moments with molecular structure, and especially with the configuration of molecules in space of three dimensions. In this way, many physico-chemical problems have already been definitely solved, and other subjects, such as the principle of free rotation, have been illustrated and elucidated. A monograph of 234 pages, with more than 60 figures, is supplemented by a table containing all the previously determined dipole moments, with references to 319 papers in which the data in question are recorded.

Some Geological Aspects of Recent Research on Coal*

By Prof. H. G. A. Hickling

I BELIEVE that coal is not only in itself worthy of more attention at the hands of the geologist than it has been generally accorded, but also is likely to repay that attention by shedding light on some of the major problems of geological science. Later, I shall revert to the conception of coal as a metamorphic rock. The idea is ancient, but the data necessary for its establishment and more precise definition have been lacking. Perhaps they are now to hand. If that be so, we have in this familiar rock an indicator of crustal conditions far more delicate than any of the index minerals of the metamorphic petrologist; so delicate indeed, that should it come within range of even the lowest grade of metamorphism, as usually understood, it is completely shrivelled up and leaves only a trace of graphite as witness of its former self.

STRUCTURE OF COAL

So far back as 1831, Henry Witham had prepared microscopic sections in which he had seen plant structure, and in January 1833, a paper was read before the Geological Society of London, by William Hutton, based on the examination of a considerable collection of thin sections. It was, unfortunately, published in brief abstract only, but the original manuscript, at present in my possession, shows that he had observed most of the features which were noted by later observers until very recent times. This was the first serious attempt to determine the structures of the different kinds of coal, and little advance was made in this matter for more than half a century.

The modern period of coal petrology is clearly the offspring of the palæobotanical research on petrified coal which culminated at the close of the nineteenth century. This work gave us a precise knowledge of the structure of the plants which formed the Carboniferous coals, and a clear picture of the condition of some of the coal peats at the time of their deposition. It was inevitable that this should be followed by more determined attempts to see these structures in the coal itself, and was equally natural that such attempts should be made quite independently by a number of workers.

THE 'UNIFORM BROWN SUBSTANCE'

Before the time of Witham and Hutton, coal was often regarded as a deposit from 'solution' in water—as a kind of vegetable 'extract', which might consequently be expected to possess a distinctive composition, independently of the materials from which it was derived. The earlier microscopic observations at once limited this idea by demonstrating the presence of plant remains which retained their organised structure; but Hutton directed attention especially to a 'uniform brown substance' as the dominating constituent of the commoner types of coal. This clearly appealed to many observers as the essential feature, and many references to the 'coal substance' seem to be more or less clearly identified with it. The foremost question in coal petrology has been, in fact, the nature of this brown substance—in particular, as to whether it is, in more modern phrase, a colloidal precipitate, or whether it represents actual fragments of plant material. Since it forms probably quite 75 per cent of all our common coal, this question is of the first importance.

All recent workers have directed attention largely to this dominating material. E. C. Jeffrey named it 'lignitoid material'. He regards it as representing pieces of plant tissue, largely woody, in which all trace of the original organisation has been destroyed by decay. Thiessen differed from Jeffrey chiefly in his belief that the structure of the original plant material is rarely quite obliterated, and that it can nearly always be detected if the sections and the microscopic technique be sufficiently good. He named the material 'anthraxylon'.

In 1919, Dr. Marie Stopes essayed a classification of the types of coal substance which can be distinguished by eye in an ordinary bituminous seam. While earlier writers had usually been content to describe the coal as divisible into 'bright' and 'dull' layers, together with occasional bands of 'mineral charcoal' or 'mother of coal', she directed attention to the additional fact that the 'bright' coal might be separated into two portions. The general mass of the bright substance has a just perceptible fine lamination which gives it a silky sheen; but interbanded with it are many thin layers which at once strike the eye by the mirror-like reflection from their perfect cleavage surfaces. She applied distinctive *names* to the different types of laminæ, adopting the French *fusain* to replace the questionable English term 'mineral charcoal', and devising corresponding terms for the other types of coal: *durain* for the true dull bands; *clarain* for the ordinary silky

* From the presidential address to Section C (Geology) of the British Association, delivered at Norwich on September 6.

bright coal; and *vitrain* for the brilliant glassy-looking substance.

Turning to the microscopic characters of these types of coal, she observed that the clarain bands were mainly composed of this uniform brown substance, finely interspersed with other ingredients, and often showing its original plant structure; while vitrain consisted entirely of similar material, free from admixture with other substances, but seemed to show no trace of structure. The development of technique during the past decade has shown, however, that this latter distinction was apparent only. In direct proportion as the methods of preparing thin sections or of etching coal surfaces have been improved, an ever-increasing proportion of the 'uniform brown substance' of the bright coal has been shown to retain the structure of the plants of which it is composed.

Nature of the 'Uniform Brown Substance'

Thus the 'uniform brown substance' for the most part, at least, represents portions of plant tissue with their organised structures exquisitely preserved; and there are those who regard it as made up entirely of such fragments, each of which now consists only of the remains of the organic substance of which that particular plant fragment was originally composed. The alternative view is that a large part of the substance of the original vegetation was reduced by early decay to the condition of a true fluid, some of which was absorbed into those plant fragments which retained their organisation, while other portions of the fluid may have solidified as a truly structureless gel, and acted as a cement to the whole mass. Whatever may be the amount of truth in this latter hypothesis—and there is considerable evidence that material which must have been absorbed in a fluid condition is present in some cases—it is absolutely unquestionable that the plant remains which now form this translucent coal substance have been rendered jelly-like, whether by their own decay or by absorption of extraneous material. In nearly all cases, cell-walls which were clearly rigid have been flattened and folded without rupture. Often the entire tissue has been contorted into the most fantastic forms but still remains unbroken.

In any case there is little reason for supposing that the essential nature of this substance is very different whether the plant-structure be discernible or not; all our evidence points to a remarkable general uniformity. Its ash-content is always found to be amazingly low. Not only is it a mere fraction of that present in the rest of the coal substance, but it is much below that in any average aggregate of modern plant materials. There is no reason for supposing that the vegetation of the coal-forests was abnormal in its content of inorganic matter, so we must presume either that the inorganic content of this part of the coal has been reduced, by leaching out, or that there has been a very large addition of pure organic substance. Further, this material shows extremely little variation in its organic composition, as compared with the other constituents of the coal. While the hydrogen content, for example, in the different ingredients of a single block of bituminous coal may be found to range from 3½ to 8 per cent, the variation among samples of vitrain from the same block will rarely exceed a twentieth of that amount. It is because most coals consist mainly of this substance that they differ so little from one another. Prof. Wheeler and his colleagues have shown that it is mainly composed of ulmin compounds.

In the absence, hitherto, of any generally accepted name to denote this most important of all coal constituents, I propose for the present to adopt the term recently suggested by Dr. Stopes and call it *vitrinite*.

Other Components of Coal

We must now take stock of the other materials which go to the make-up of an ordinary coal seam. Though they are subsidiary in amount to the vitrinite in most portions of the seam, it is the character and varying quantity of these other materials which primarily differentiate the quality of the coals.

Most conspicuous and familiar is the 'mineral charcoal' or fusain. This illustrates at once the fact that in some cases the mode of preservation of the plant-substance may be of greater import than its original nature. The fusain is usually woody tissue, clearly identical originally with much of that which has been converted into vitrinite. But how different in its present form! Devoid of any organic substance in its cell-cavities; every cell-wall so brittle as to break at a touch; always extremely low in its content of hydrogen and oxygen, and correspondingly high in carbon. Physically and chemically it stands in the strongest possible contrast. On account of its porous nature, it has commonly formed the receptacle for much of the mineral matter which has been deposited from solution in the coal, and is consequently a great carrier of ash. Quite moderate variation in the amount of fusain in the coal has important effects on its utility for various purposes.

The next group of coal components may for the purpose of this review be designated the 'high-hydrogen' group—the outer coatings of stems, leaves and spores which are characterised by an accumulation of waxes, fats, resins and allied substances. They differ so strikingly in chemical

properties from the rest of the coal that by the roughest chemical treatment the remainder of the coal can be broken down while the spore-coats and cuticles are left little altered. They are then seen under the microscope to differ in structure little, if at all, from their condition in a living plant. Their obvious relative indestructibility has resulted in their accumulation in the coal in quantities much in excess of their natural proportion—in extreme cases, even to the total exclusion of other materials.

Associated with the cuticles and spores in respect of chemical peculiarities and durability, but differing somewhat in the manner of distribution in the coal, are the resinous secretions of the plants. Since the resins were originally contained in the wood or bark, they are found largely in the vitrinite of the coal. On the other hand, they are often found in local aggregations among the more disintegrated plant debris, in such a manner as to suggest that the aggregates may represent the resinous content of a tissue which has, for the rest, been almost entirely destroyed.

There is one other distinctive ingredient in most ordinary coal seams, characterised by its minute state of fragmentation. It forms a kind of paste made up of particles of 1 or 2 microns or less in diameter. Obviously it represents quite a distinct stage in the degradation of the plant material; and there is some indication that it has distinctive chemical peculiarities. It is of very dense colour, and is consequently opaque except in the thinnest sections. It is essentially characteristic of the dull coals. So far it lacks a generally recognised title and has been merely described as the 'residuum'. Dr. Stopes would christen it 'micronite'.

'SAPROPELIC COALS'

The foregoing account of the components of coal deals with those to be found in our normal bituminous coals of Carboniferous age. So far as my knowledge extends, the account does not require material modification in reference to the coals or lignites of other ages. But there are other types of coal, particularly the cannels and bogheads, which have a widely different structure and at least one very different component material; namely, the microscopic oil-bearing algæ. In the last few years these organisms have been carefully re-examined by Zalessky, by Thiessen, by P. Bertrand, and by my own colleague Dr. Temperley, who have not only demonstrated their structure in greater detail, but also have established their essential similarity (and possible identity) with the living oil-alga *Botryococcus braunii*. This constituent of the cannels affords the most striking of all examples of the effect of original materials on the composition of the coals. As the algal content increases, so the percentage of hydrogen in the coal rises, from about 6·0 per cent in those without algæ up to more than 12 per cent in the purest algal bogheads.

(*To be continued.*)

Birkbeck College

PAST, PRESENT AND FUTURE

THE successful inauguration of the appeal for the rebuilding of Birkbeck College, originally the London Mechanics Institution (see NATURE, Nov. 16, p. 787), will be welcomed universally by students of science. The College, established at a meeting of 'mechanics' held in the Crown and Anchor Tavern in the Strand on December 2, 1823, had as its original purpose to provide scientific education for the skilled craftsmen who were the aristocracy of the Industrial Revolution. That the objective was education and not mere technical training is proved by the motto of the Mechanics Institutes established throughout the country: "To make a man a better mechanic we must make the mechanic a better man".

In the early days, as Mr. Ramsay MacDonald, a former student of the College, has said, their science was simple and stimulating. "Its revelations were both startling and fresh; the controversies it roused were popular and the prospects it opened were inspiring." The opposition encountered by Birkbeck was essentially opposition to scientific training. "What is wanted," said Bell's *Weekly Messenger*, "is practical mechanics—instruction in trades . . . Science, in the very nature of things, must be confined to a few"; and the *St. James' Chronicle* asserted that "a scheme more completely adapted for the destruction of this empire could not have been invented by the author of evil himself. . .". Carlyle, in "Sartor Resartus", denounced its students as "professed Enemies of Wonder", cackling "like true Old-Roman geese and goslings round their Capitol, on any alarm, or on none"; as illuminated sceptics guiding people with rattle and lantern when the sun is shining. He resented "that progress of Science which is to destroy mystery".

Science has withstood these attacks and has captured some of the strongholds of the older culture. Birkbeck College can claim to have acted as *éclaireur* to the "march of mind" and to recapitulate the history of scientific instruction in Great Britain; this proud claim should ensure the success of its appeal.

The College, as we have said, stands for education in a broad sense, but it stands also for another great principle—part-time education. Hundreds of examples of the value of part-time education could be cited from the records of the College, but the one selected by the Archbishop of Canterbury in his speech at the Mansion House meeting is of outstanding interest. Sidney Gilchrist Thomas (1850–85), a police court clerk, attended George Chaloner's chemistry class in the College. The lecturer remarked that "the man who eliminates phosphorus by means of the Bessemer converter will make his fortune". From 1860 onwards, Sir Henry Bessemer and many others had studied this problem, a problem of great economic importance, since its solution would render available vast deposits of iron ore in England, Germany and the United States. Gilchrist Thomas solved the problem and received the promised guerdon. This wealth was not, however, the incentive to the discovery, for his biographer states that "he held 'advanced' political and social views and had he lived he had intended to devote his fortune to the alleviation of the lives of the workers". The money was spent in philanthropic objects after his early death. "A rare young man", as Gladstone observed! Let it be added that the scientific equipment provided at the College at this period was of the simplest. The room, said Bernard H. Becker in "Scientific London" (1874), might (were it not devoted to the use of science) be designated the back kitchen. A couple of glaring 'butcher's lights' illuminated a rough deal table from behind which Mr. Chaloner expounded the properties of carbonic acid gas. But he added, —and this sounds the keynote of the history of the College—"the lecturer and the audience evidently mean business".

In recent years, the College has catered for two groups of students who are to be found in large numbers in London and the surrounding districts. The first consists largely of teachers, civil servants, technical chemists and others who have missed the usual university training and are willing to give their evenings to working for a degree. The second group comprises graduates in arts and science of London and other universities who have a keen desire to pursue post-graduate studies and research. For many years the lecture rooms and laboratories have been seriously overcrowded by both types, and each year a number of keen and deserving students has been refused admission owing to limitations of space.

New buildings and more space are urgently needed to enable the College to serve effectively the needs of the present generation. When the College was founded in 1823, two men in every three and nine women in every ten could neither read nor write. When it was rebuilt in 1883, elementary education was in its infancy. To-day the mesh of the scholarship net is so fine that the time is not far distant when all who are fitted for university education will be provided for in the ordinary course.

What then is Birkbeck's future? It has provided adult education in fundamental subjects; it has led its students along the paths of the polytechnic, and inspired them to scale the academic heights by degrees—now it has entered upon a greater role —the provision of opportunities for research for those whose everyday occupations are in other fields.

Schmidt and the Eels

Danish Eel Investigations during Twenty-five Years

ON June 22, sixty miles west of Ringkjöbing, Jutland, the research ship *Dana*, built by the British Admiralty during the War and sold to the Danish Government in 1921, was sunk in collision with a German trawler in a fog. Happily there was no loss of life; but, with her, was lost all her scientific equipment and the material of her latest cruises. Johannes Schmidt, who made the *Dana* famous, had died all too soon, a comparatively young man, on February 21, 1933. When his ship went down, it was as if a chapter of oceanographical history came to an end. The little brochure "Danish Eel Investigations During Twenty-five Years, 1905–1930", recently issued by the Carlsberg Foundation, Copenhagen, may be regarded as the epilogue to the story.

There is nothing new in this publication. The text is taken from Schmidt's report of his famous voyage round the world. It was his intention that the report, written in Danish, should be done into

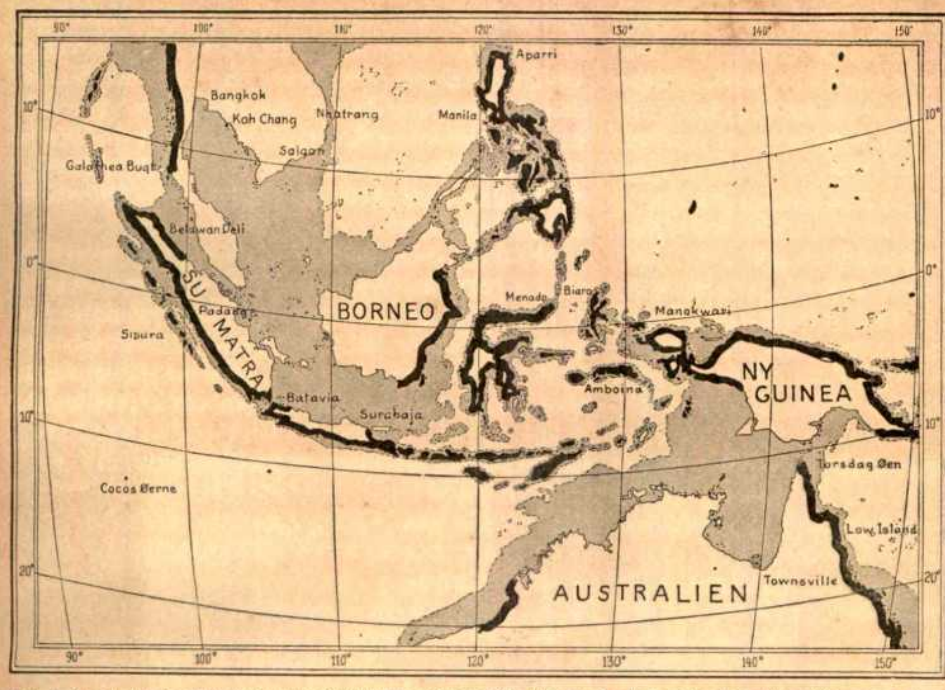


FIG. 1. Chart of Indo-Malaya showing distribution of the eel (in black). Shallow water (less than 200 metres deep) is shaded and deep water and land areas are white. Note that eels do not occur off coasts facing shallow water regions (Sumatra, Java, Borneo, Siam, etc.)

English, or at least French. That intention was not fulfilled, but Schmidt's summary record of the Danish eel investigations, of which he had been the leader since 1905, has been lifted out of the report and published in English. The record is illustrated and expanded by the addition of figures, with appropriate text, from others of Schmidt's papers, and the brochure concludes with a list of Schmidt's papers on eel investigations and a brief record, with illustrative charts, of his various eel expeditions. Three of the illustrations are reproduced herewith by courtesy of the Carlsberg Foundation.

For those who followed Schmidt's voyages as they took place, this paper is an interesting summary of their results, as regards eels, and of his conclusions from them. To the student approaching the question for the first time, it will be a stimulating introduction to what Schmidt describes as "the Eel question", and a useful guide to the literature. One cannot read it without a feeling of deep regret that he did not live to pursue the subject further and to check his own conclusions, as we may be sure that he would have done if he had not been cut off in his prime.

As a summary statement of the facts and Schmidt's interpretation of them, this document is a masterpiece of compression. Schmidt believed that he had successfully identified every species of the genus *Anguilla*. Besides the two Atlantic species—the European and the North American—he was sure of six species in the countries bordering the Indian Ocean, and "about twelve in the countries by the Pacific", of which some were common to both oceans. Actually, only ten non-Atlantic species are named in the paper, but this reflects the summary character of the statement. The main fact that emerges from his investigations is that all the fresh-water eels without exception require for spawning waters of great depth and high salinity. This fact is illustrated by charts,

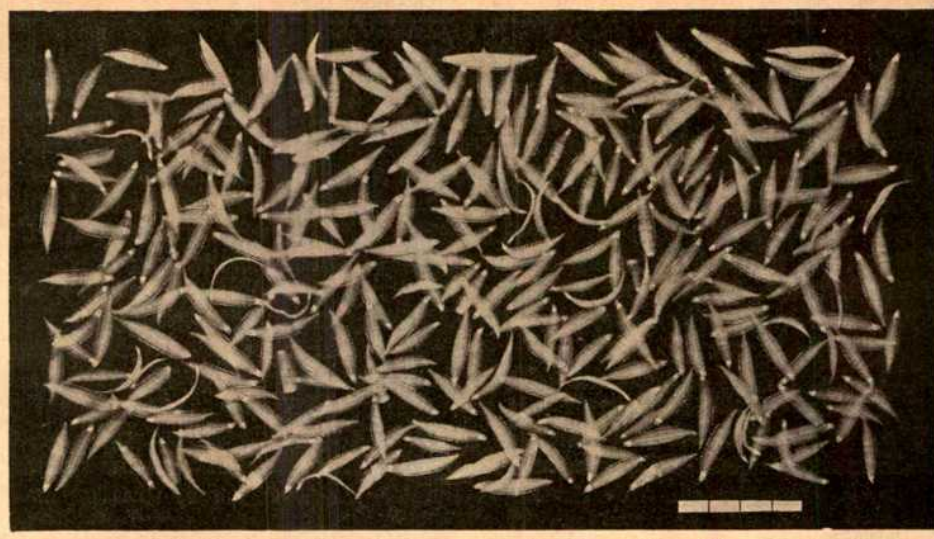


FIG. 2. Larvæ of the European eel from the Sargasso Sea. Note the small size and the uniformity of the larvæ. Scale shows centimetres.

which demonstrate in truly remarkable fashion how the concentrations of small larval eels are found in the deepest waters and how, even among the islands of Indo-Malaya, eels are not found at all on the coasts facing extensive areas of shallow water (Fig. 1).

Another important fact is that, just as the larval period of the North American eel, which has a less distance to travel, is appreciably shorter than that of the European eel, so the eels of Indo-Malaya, which Schmidt studied most intensively of the Pacific species, are still more rapidly metamorphosed. Although some of them reach a very much greater size than the European eel, their larvæ, both in the earliest and in the latest stages, are much smaller. Moreover, whereas in the Sargasso Sea a haul of eel larvæ will be all small and practically identical in size (Fig. 2), in the Mentawei Deep, west of and at no great distance from Sumatra, which is the spawning area of three species, they are found together at all stages of development, and, nearer to the coast, the larger larvæ and the elvers are found freely intermingled (Fig. 3).

Schmidt's most remarkable conclusion is that not only are all the fresh-water eels of tropical origin, but also that "the most westerly equatorial Pacific is the domicile of the Eel genus from which it has distributed itself over those parts of the world where conditions are favourable for it to thrive". Considering that no eels are found on the east or west coast of South America, and none on the west coast of Africa, it is difficult to reconcile with this conclusion the distribution, as proved by Schmidt, of the European and the North American eel, unless, indeed, one glances back in imagination over the ages to some remote, cataclysmic change of the earth's crust and of the distribution of the oceans.

One may hesitate to accept without question such a far-reaching conclusion, but one cannot read this paper without renewed admiration for Schmidt's genius. In particular, the thoroughness with which he did his work, and the forethought with which he laid his plans are remarkable.

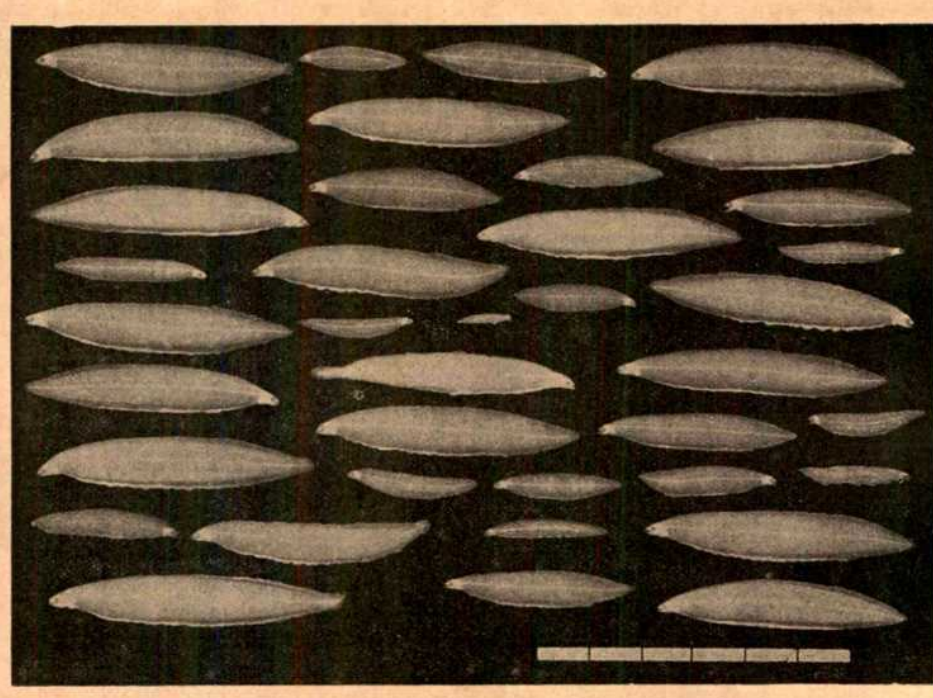


FIG. 3. Larvæ of freshwater eels from the Mentawei Deep, west of Sumatra. All stages of development are present. Scale shows centimetres.

From 1922 onwards, thousands of eels from all parts of the world were examined at Copenhagen, with the view of obtaining information as to the distribution of each species and such knowledge of the adult eels as would facilitate the recognition of their larval forms. In 1926, Schmidt himself visited Australia, New Zealand and Tahiti, for the purpose of completing his records. Not until he was satisfied that he had thoroughly charted the distribution of the eels in fresh water did he embark upon his round-the-world expedition, the chief purpose of which was to chart their spawning places in the sea, and thus, while elucidating their life-history, to throw a new light on the European species, chiefly distinguished from its relations of the Pacific and Indian Oceans by its amazing instinct for travel.

Obituary

Prof. J. Goodman

JOHN GOODMAN, who died on October 28, was born on May 1, 1862, at Royston, Herts, receiving his school education at Gravesend and Cambridge. His engineering training followed the orthodox lines of that period—a long apprenticeship of five and a half years, followed by a spell of two years as an assistant to the chief engineer. During this period, by attendance on evening courses and private study, he acquired such a sound knowledge of the scientific principles upon which engineering is based that he was able in 1885 to win a Whitworth scholarship, and entered University College, London, when the chair of engineering was held by Sir Alexander B. W. Kennedy, and in 1886 he became an assistant to his professor.

A short period of service as chief assistant in the Broadway Testing Works, Westminster, was closed by Goodman's appointment in 1890, at the early age of twenty-eight years, to the chair of civil and mechanical engineering at the Yorkshire College, Leeds (now the University of Leeds), in succession to Prof. Archibald Barr, who had been appointed to the chair of engineering at Glasgow. Goodman held this chair for thirty-two years, and, when he resigned in 1922, was made emeritus professor, and was given special accommodation in the University Engineering Laboratories to enable him to carry on the research work which had always been such an important feature of his university work.

Prof. Goodman was an ideal engineering professor, a fluent, lucid lecturer, able always to maintain the interest of his students, and much beloved by them for his deep interest in the social side of their university careers, and by the special efforts he always made to assist them in securing a start in the practical side of their profession. His output of research work was remarkable in view of the amount of teaching work he undertook; the results of these researches, very largely in the field of lubrication of bearings, on the design of roller bearings, on anti-friction metals, and the stresses in crane hooks, etc., were published in numerous papers in the *Transactions* of the Institutions of Civil and Mechanical Engineers. The Institution of Civil Engineers, to which he was elected in 1887, becoming a full member in 1900, awarded him a Miller scholarship and a Telford premium; he became a full member of the Institution of Mechanical Engineers in 1890. Apart from these papers dealing entirely with the results of research work, Goodman was the author of a well-known textbook—"Mechanics applied to Engineering"—which has gone through several editions, and has been recognised as a standard work for the young engineering student.

During the Great War, Goodman was attached to the Royal Air Force with the rank of major, and did valuable work in the field of aircraft construction. He was never married. T. H. B.

Sir Temistocle Zammit, C.M.G.

WE regret to record the death, which occurred on November 2 at the age of seventy-one years, of Sir Temistocle Zammit, formerly rector of the University of Malta.

Temistocle Zammit was born in Malta in 1864 and educated at the local university, where he took the degree of M.D. in 1889. Entering the service of the Government of the island as an analyst, he became a member of the commission appointed by the Colonial Office and the Royal Society to investigate malaria. In 1904 he represented the Government on the Mediterranean Fever Commission, and in the following year became professor of chemistry in his University. To him was due the discovery which led to the recognition of the organisms of Malta fever in the blood of the native goat, and in 1908 he became a member of the Commission appointed to combat this disease. For the remainder of his life, such time as could be spared from his other pre-occupations was given to research in this direction. From 1920 until 1926 he was rector of the University. He was a member of the Council of Government and of the Executive Council of Malta. He received the Mary Kingsley Medal of the Liverpool School of Tropical Medicine in recognition of his services in medical research.

While Zammit's services to medical science were widely recognised among members of his own profession, he was far more widely known as an archæologist, more especially for his contributions to our understanding of the obscure archæological problems in the prehistory of Gozo and his native island. After he had been appointed curator of the Malta Museum in 1903, he discovered and excavated the neolithic temples of Tarxien and Imgiar, and took in hand and completed the excavations already begun in the other subterranean temples of Malta. In 1926, after his retirement from the rectorship of the University, he became director of the enlarged Museum Department, and brought together and arranged a remarkable exhibit of Stone Age antiquities such as is unsurpassed elsewhere. It is entirely owing to his enthusiasm and knowledge that the antiquities of Malta have been made more accessible and more easily intelligible to the visitor to the island, whether archæologist or layman, than in any other European centre of archæological interest. Under his editorship, the official publications of the Department became a valuable source of first-hand information. He was the author of "Malta, the Island and its History" (1926) and "The Neolithic Temples of Tarxien" (1930), indispensable to the student of the early history of the Mediterranean.

The honorary degree of D.Litt. was conferred on Zammit by the University of Oxford in 1920. He was made a C.M.G. in 1911 and knighted in 1930. He was also an honorary fellow of the Royal Anthropological Institute.

News and Views

Nobel Prize for Physics: Prof. J. Chadwick

THE award of the Nobel prize for Physics for 1935 to Prof. James Chadwick and that of Chemistry for 1935 to M. and Mme. Joliot-Curie are associated with two of the most important discoveries of recent years, that of the neutron and of artificial radioactivity. Prof. Chadwick worked in Lord Rutherford's laboratory, and M. and Mme. Joliot-Curie in that of Mme. Curie, and it will be felt by all how fitting it is that these two latest awards should be connected in this way with the two great founders of nuclear physics. In 1919, Prof. Chadwick went with Lord Rutherford to Cambridge from Manchester, where he had taken his degree and worked before the War. His first research in the Cavendish Laboratory, on the scattering of α-particles, still remains one of the most important direct determinations of the nuclear charge of the elements. Then for many years he worked in collaboration with Lord Rutherford on the artificial disintegration of the elements by α-particles. These fundamental researches really laid the foundations on which modern nuclear physics is built. The scintillation method of counting the particles was the only certain method available at that time, and further advance was checked by its limitations. Prof. Chadwick was intimately connected with the development of electrical methods of counting, and applied them to a detailed study of the disintegration of some of the light elements. These investigations were of the highest importance since they yielded precise information about the nuclear energy levels.

WHEN M. and Mme. Joliot-Curie reported the anomalous behaviour of certain radiations emitted in the transformation of beryllium by α-particles, Prof. Chadwick was able in a very short time to carry out a brilliant investigation which showed, beyond doubt, that the neutron had at last been detected. The possibility of such a particle had often been discussed, and as early as 1922 experiments were made in the Cavendish Laboratory in the hope of finding something of this nature. In his first communication, Prof. Chadwick gave quite an accurate estimate of the mass of the neutron, and with various collaborators began a thorough investigation of its properties, particularly that of its power to disintegrate other elements. Recently, by investigating the disintegration of the deuteron by γ-rays, he has obtained what is generally accepted as the most dependable value for the mass of the neutron. The importance of the discovery of the neutron may best be realised when it is remembered that it has changed completely and simplified our ideas of the structure of nuclei.

Nobel Prize for Chemistry: M. and Mme. Joliot-Curie

M. AND MME. JOLIOT-CURIE have long been distinguished for their work in various branches of radioactivity. After the discovery of the positive electron, they made several investigations of its mode of production, and quite early concluded that it could be formed in some manner other than by the action of γ-rays. In particular they observed positive electrons to accompany neutrons in the disintegration of certain light elements by α-rays. Further investigation of this led them to the striking discovery that while the neutrons were emitted simultaneously with the bombardment by the α-particles, the emission of positrons was an entirely separate process occurring after the source of α-particles had been removed. By a variety of experiments, they were able to show that they had formed new radioactive bodies, and in many cases they were able to verify the chemical nature of the substances by using their radioactive properties as an indicator. This is a discovery of fundamental importance, and has provided a new and powerful method of investigating the transmutations of bodies. In the last year this work has been much extended by the proof that the neutron is very effective in forming new radioactive bodies, and both these and all other investigations have only tended to increase the importance of this new phenomenon, which in addition to furnishing many new isotopic species, promises to throw great light on the true nature of radioactivity.

Medal Awards of the Royal Society

HIS MAJESTY THE KING has approved of the awards this year by the president and council of the Royal Society in respect of the two Royal Medals to Prof. C. G. Darwin, Tait professor of natural philosophy in the University of Edinburgh, for his researches in mathematical physics, especially in the quantum mechanics of the electron and in optics, and to Dr. A. Harker, emeritus reader in petrology in the University of Cambridge, in recognition of his distinguished work and influence as a petrologist. The following awards of medals have also been made by the president and council: Copley Medal to Prof. C. T. R. Wilson, emeritus professor of natural philosophy in the University of Cambridge, for his work on the use of clouds in advancing our knowledge of atoms and their properties; Davy Medal to Prof. A. Harden, formerly head of the Department of Biochemistry of the Lister Institute, for his distinguished work in biochemistry and especially for his fundamental discoveries in the chemistry of alcoholic fermentation; Hughes Medal to Dr. C. J. Davisson, of the Bell Telephone Laboratories, New York, for research resulting in the discovery of the physical existence of electron waves through long-continued investigations on the reflection of electrons from the crystal planes of nickel and other metals.

New Officers of the Royal Society

THE following is a list of those recommended by the president and council for election to the Council of the Royal Society at the anniversary meeting on

November 30: *President*, Sir William Bragg; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Frank Smith and Prof. A. V. Hill; *Foreign Secretary*, Prof. A. C. Seward; *Other members of Council*, Prof. E. D. Adrian, Mr. D. L. Chapman, Prof. A. W. Conway, Dr. W. H. Eccles, Prof. A. S. Eve, Prof. L. N. G. Filon, Dr. J. Gray, Sir Daniel Hall, Dr. S. W. Kemp, Sir Patrick Laidlaw, Sir Gerald Lenox-Conyngham, Prof. G. T. Morgan, Prof. R. Robison, Dr. Bernard Smith, Prof. W. Stiles, Mr. W. Trotter.

Dr. P. Kapitza's Apparatus and the U.S.S.R.

A REPORT published on November 19 in the *Cambridge University Reporter* gives an account of a proposed arrangement for the transfer of apparatus from the Royal Society Mond Laboratory at Cambridge to a new laboratory which is being built for Dr. P. Kapitza in the U.S.S.R. It will be remembered that Dr. Kapitza was refused leave to return to England after his visit to Russia in September 1934. In the report of the Committee for the Laboratory, it is pointed out that much of Dr. Kapitza's work in Cambridge had been preliminary to the experiments with strong magnetic fields at the temperature of liquid helium which he was on the point of beginning before he left for Russia, and that members of the Laboratory would not care to take up these experiments if Dr. Kapitza wished to resume work at once in this field. It is therefore suggested that the large generator for the production of strong magnetic fields, together with its associated apparatus, should be sold to the Government of the U.S.S.R. for the use of Dr. Kapitza. The remainder of the apparatus in the Laboratory, including the apparatus for the production of liquid hydrogen and liquid helium, would not be transferred since it is in constant use and will be required for the future work of the laboratory. It is proposed, however, to supply duplicates of this apparatus for transfer to Russia, so that Dr. Kapitza will have equipment identical with that he had developed in Cambridge. With the sum received for this apparatus it is proposed to buy new equipment suitable for the future work of the Laboratory. Such equipment might include a large electromagnet which could be used for nuclear research or for the production of low temperatures by the method of adiabatic demagnetisation.

Prof. Ejnar Hertzsprung

IN connexion with the recent announcement that Prof. Ejnar Hertzsprung, professor of astrophysics in the University of Leyden, and assistant director of the Leyden Observatory, has been appointed director of the Observatory to succeed the late Prof. W. de Sitter, it may be recalled that Prof. Hertzsprung was awarded the Gold Medal of the Royal Astronomical Society in 1929. Prof. Hertzsprung's work covers an extremely wide range of astronomical subjects, and he has contributed to our knowledge in nearly every branch of the science. In particular, he is known for his work on double stars and on the clusters. The mass luminosity relation, the division of the late type stars into giants and dwarfs, and the connexion between absolute magnitude and spectral type (the famous 'seven diagram') are all associated with his name (together with that of Prof. H. N. Russell, of Princeton). He will have as his assistant director at Leyden, Dr. J. Oort, who is also well known in Great Britain, chiefly on account of his work on galactic rotation.

"Everyday Science" and Civil Service Examinations

FOR several years "Everyday Science" has been one of the obligatory subjects of the competitive examinations for the important administrative group of Government services, comprising the Indian and Ceylon Civil, the Foreign Office and Diplomatic, the Consular and Overseas Trade (Intelligence Officer) and Home Civil (Junior Grade of the Administrative Class). We notice with astonishment and regret, therefore, the announcement of the Civil Service Commissioners that, with effect from next year, the subject will be omitted; some *optional* questions on science will be included under the subject "Present Day". The scope of the "Everyday Science" paper, now to be discontinued, is indicated by the following passage: "Such knowledge will be expected as candidates will have who have studied science intelligently at school and have since then kept their eyes open. A liberal choice of questions will be given. Attention should be paid to orderly, effective, and exact expression". The other parts of the obligatory section of the examination are: Essay, English ("to test the understanding of English and the workmanlike use of words"), "Present Day" (being questions on contemporary subjects, social, economic and political, calling for effective and skilful exposition), auxiliary language and viva voce. The inclusion of "Everyday Science" must have exerted an influence on school and college courses, and its omission will be regretted by many who believe in the value of "general science" teaching in schools and hold it to be plainly wrong (to quote the words of Mr. C. M. Bowra in *Time and Tide's* recent university supplement on "More and More of Less and Less") that highly educated men should know next to nothing of the structure of the universe or of their own bodies.

Royal Institution: Legacy of the late Mr. Harry Brown

FROM a statement recently issued by the Managers of the Royal Institution, it is understood that the munificent bequest to the Institution by the late Mr. Harry Brown, of the residue of his estate, reported in April last, is expected to amount to approximately £28,000. This large sum has been given without restriction as to its use, but the Managers hope to apply it mainly to the extension of experimental research, one of the two principal objects of the Institution's work. Shortly after information as to the legacy had been received, the freehold of 19 Albemarle Street, immediately adjoining the Davy Faraday Research Laboratory and the rest of the Institution's buildings, came into the market. With the double object of investing Mr. Brown's legacy and providing for future extensions of the premises, it was resolved to purchase the property. The

purchase has now been completed. For the present, the Institution will use the top two floors of the new house for storage of books and apparatus, releasing valuable accommodation elsewhere for other purposes. It is proposed to let the lower floors, and to devote any income obtained to research purposes. Eventually, as the research activities are enlarged, it may prove necessary to occupy a larger part of the house.

Royal Institution: Reconstruction of the Library

ABOUT April last it was noticed that a sinking had occurred of the ceiling of the Library on the first floor at the Royal Institution, and of the floor of Sir William Bragg's rooms immediately above. The ceiling, which was old and of timber construction, was found to be defective. It was temporarily propped, and at the end of the lecture season a thorough examination was made. An astonishing state of disrepair was discovered. Not only was the heavy timber ceiling defective, but also the brick walls upon which it was supported were cracked and broken in all directions. The examination was carried down to the rooms on the ground floor and here a similar state of affairs was revealed. When in 1799 the Royal Institution was founded, a large town house was purchased and considerably altered to suit its new purpose. Further alterations have been made at intervals. Vulliamy added the Corinthian column front in 1837. In 1930 a large part of the building, including the lecture theatre, was completely reconstructed, but the Library and rooms below it were left untouched. These it has now proved necessary to rebuild, largely, it must be said, due to faulty workmanship in the past, as the various alterations to the structure have been made.

THE reconstruction is now in progress. The defective brickwork of the walls is being replaced, including that of the front wall, which is being worked at from the inside, so that the elevation to Albemarle Street will remain untouched. New fire-resisting floors are to be supported on a steel structure, which is being erected within the walls. The steelwork, the foundations for which are being carried to basement level, will also serve to strengthen the rebuilt walls. When completed, the rooms on the first and second floors will appear much as they were before, but advantage is being taken of the alterations to construct a large new research laboratory in the basement. The work is expected to be completed about April next, and it is understood that it will cost about £12,000.

November Floods

THE past week or so has been characterised by rains and floods of exceptional severity, extending over a widespread area in western Europe, including the Rhone Valley, the Riviera, parts of Switzerland and of Great Britain. At Avignon, in the south of France, a large section of the town was inundated in places to depths of so much as six feet, and the famous Pont d'Avignon has been seriously damaged. At Nîmes, the Rhone reached the record height of 26 feet, and about 125 square miles of the valley were submerged. As an unfortunate consequence of so disastrous a visitation, there has been much distress and several deaths among the inhabitants of Provence and Languedoc. One village, Aurlot, near Marseilles, has been almost destroyed, whilst in various districts, thousands of people have been rendered homeless. Damage has also been reported from Fréjus and Hyères. In Switzerland, wide areas near Geneva have been under two feet of water, and it is stated that no such floods have been recorded since so far back as 1890. The rainfall was particularly persistent and lasted without intermission for sixty hours.

IN Great Britain, inundations of considerable tracts have followed locally unprecedented rainfalls for November, the first seventeen days of the month having yielded about twice the amount of rain normally experienced at a number of places in the south of England. Flooded districts are reported from Swanage in Dorset and many parts of Kent and Sussex, while in the Midlands, the River Trent has overflowed its banks. The Thames valley has also been seriously affected. Presiding at the meeting of the Thames Conservancy Board on November 18, Lord Desborough, the chairman, said that the state of the river was causing some anxiety. The flow was exceeding the 'root figure' (when the river is flowing bank high) by a thousand million gallons daily. The 'root figure' for the discharge of the river is 4,500 million gallons a day measured at Teddington; the comparable November average is 1,486 million gallons a day. The rainfall in the Thames Catchment Area had been quite exceptional for the time of the year. In September, there was a rainfall of 4·59 inches; in October, 4·09 inches and for 17 days of November, 4·11 inches. The total for two and a half months was 12·79 inches. Looking back over previous records, Lord Desborough said he had not been able to trace a similar case. The unexpected and catastrophic occurrence of such floods serves to emphasise the importance of the national inland water survey, so repeatedly advocated in NATURE, and now in the hands of a committee of the Ministry of Health, appointed nearly a year ago, under the chairmanship of Sir Henry Lyons. It is obvious that only by accurate and reliable records of floods can adequate precautionary measures be devised and undertaken so as to remove a serious menace to life and property.

Brauner Memorial Lecture

FROM the time of the founding of the University at Prague in 1347 by Charles IV, Bohemia has been an important centre of learning. Komenský, Purkyně and Mendel all attained fame beyond the frontiers of their country, but the first Czech chemist to gain world-wide recognition was Prof. Bohuslav Brauner, who died on February 14 of this year. He had been a student at Manchester under Sir Henry Roscoe in the 'eighties, and whilst in England began some of his famous researches on the rare earths. He came to acquire an international reputation also by his advocacy of Mendeléeff's Periodic Law, to the

substantiation of which he directed his investigations, especially his redeterminations of atomic weights. He was elected an honorary and foreign fellow of the Chemical Society soon after the Great War, and the Society's Brauner Memorial Lecture was delivered by Dr. S. I. Levy on November 14. Dr. Levy has himself contributed to our knowledge of the rare earth elements and he was able to give a very lucid account of the way in which these very similar and difficultly separable bodies were isolated and identified as pure substances. Brauner's share in this work was very great, and is all the more noteworthy since it was very largely performed in adverse circumstances, for it was not until 1903 that the chemical institute of the Charles University of Prague was erected, largely as a result of Brauner's insistent pleas.

FROM his exhaustive researches, which led, among other things, to the fractionation of didymium into praseodymium, neodymium and samarium, Brauner came to the conclusion that the rare earth elements from lanthanum to lutecium should be placed together in the Periodic Table. Brauner's other contributions to chemistry include his work upon the compounds of cerium and tellurium, concerning the homogeneity of which he was for a long while doubtful. It is interesting to note that some of his atomic weight determinations, even those of forty years ago, remain the accepted standards even to-day. It has perhaps never been generally realised how great his contributions were to the fundamentals of inorganic chemistry. Few of Brauner's original British friends remain. They include Mr. W. Macnab, who came to move the vote of thanks to Dr. Levy, and who recalled how Brauner's fine physique and unconventional, friendly manner always attracted admiration. Reference was made by Dr. G. Druce in seconding the vote of thanks to Brauner's interest in the transcription of Russian names into English, concerning which he had written several times in NATURE, and to the rapid progress in scientific research in many fields at Czechoslovak universities, largely as a result of Brauner's inspiring influence and example.

Anatomy Department of St. Thomas's Hospital

IMPORTANT alterations and additions to the Anatomy Department of St. Thomas's Hospital Medical School, London, have just been completed, and an "At Home" was held in the Department on November 14 when it was visited by representatives of the universities and of various London hospitals. Three new research laboratories and a large radiological laboratory, together with a director's room and an office, are housed in the new block. The dissecting-room has been completely renovated, and a new terrazzo floor has been laid. The museum has been equipped with special lighting arrangements for the exhibition of lantern-slides, X-ray negatives, bottled specimens and models. The X-ray equipment is of the latest pattern, and is completely shock-proof, and will serve not only for the instruction of students in all normal radiological appearances but also for research. An optical bench for photomicrography and for the reduction of X-ray negatives has also been accommodated in the radiological laboratory, adjacent to which is a dark-room. The research laboratories are situated in the upper floor of the new block. They are magnificently lighted, and are furnished throughout with the most modern fittings. The visitors were afforded an opportunity of seeing some of the results of experiments which are being carried out in the Department in the use of the cinematograph for the teaching of anatomy. A composite film comprised portions of films showing respectively a dissection of the forearm, some examples of muscle-nerve paralyses, the surface anatomy of normal shoulder movements and a dissection illustrating the mechanism of the knee-joint. This Department is admirably fitted for the teaching of anatomy by modern methods, with emphasis on the study of living anatomy.

Sir James Walker and the University of Edinburgh

To commemorate the services of Sir James Walker, professor of chemistry at the University of Edinburgh from 1908 until 1928, to chemistry in general and to the Chemistry Department of the University of Edinburgh in particular, it is proposed to establish a fund for a Walker Memorial Lecture to be delivered annually by an eminent chemist invited to Edinburgh by the Edinburgh University Chemical Society for that purpose. Sir James Walker, who died in May of this year, was the leading exponent of physical chemistry in Great Britain for nearly fifty years. During the Great War he did valuable work in the manufacture of high explosives, and the new chemical laboratories which he designed and fitted up at Edinburgh are among the foremost, both in equipment and in research activity, in Great Britain. The Chemical Society of the University of Edinburgh enjoys the distinction of being the oldest chemical society in the world, since it has recently been established that it existed as far back as 1785 under the sponsorship of Joseph Black. It is felt that a yearly meeting at which the student members of this body may have the opportunity of making direct contact with the researches of distinguished investigators in chemistry from other universities will provide a most stimulating permanent memorial of the labours of Sir James Walker for the advancement of the science in Edinburgh and elsewhere. Former students of Sir James Walker and any others who may wish to assist in the project are invited to send contributions to Mr. J. E. Rocca, honorary secretary of the Edinburgh University Chemical Society, King's Buildings, West Mains Road, Edinburgh.

Memorial to Viscount Grey of Fallodon

LORD ARMSTRONG, president of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, has issued an appeal for subscriptions towards a permanent 'North Country' memorial to commemorate the life of Viscount Grey. It is proposed to place a tablet to the memory of the great statesman and bird-lover in the Hancock Museum and to found a trust fund, the income of which will be applied to the endowment of the Museum. This

is a purpose which Lord Grey himself would have applauded, for he took much interest in the Museum, and was concerned about the upkeep of the many valuable and historically interesting collections which it contains. The Museum itself was built in 1884 to house the natural history collections of the Society, and with subsequent additions it has cost approximately £45,000. But the cost of upkeep and staffing is more than the Society can bear, even although the membership is now greater than at any time during the hundred and six years of the Society's existence. A sum of £1,000 has been promised anonymously if three other donors are each prepared to subscribe a similar amount, but it is to the generosity of the many lovers of Nature, and particularly those of the north of England, that Lord Armstrong and the Society look for the safeguarding of the Museum and its collections.

Explorations in Ellesmere Island

THE Oxford University Arctic Expedition of 1934–35 under Dr. N. Humphreys was forced to winter at Etah in north-western Greenland instead of on Ellesmere Island; but during the summer of this year they split up into small parties, each accompanied by Eskimo, and explored various parts of the north and centre of Ellesmere Island. Three articles on their work have appeared recently in *The Times*. An attempt to cross the Grinnell Land ice-sheet failed, but a crossing was made to the south by the narrow isthmus between Flager and Bay fjords, thus linking up with Isachsen's former work on the west coast. A more important journey was made in Grant Land from Fort Conger, Greely's camp of half a century ago, via Lake Hazen to the lofty United States Range. From a summit of 9,000 ft. there was a good view clear to the north. The country seems to be entirely mountainous and difficult to cross. The lofty ranges to the northward were named the British Empire range. They appear to flank the northern side of Ellesmere Island, and their relation to the Challenger Mountains farther west, discovered in 1876 by Aldrich, will be of interest when revealed. These mountains are probably related to the Caledonian foldings of northern Greenland. A third party carried out some surveys in Scoresby Bay, which hitherto had been inadequately examined. The expedition returned to England in October bringing large collections.

Organisation of the Coal Industry

SIR HAROLD HARTLEY, addressing the Institution of Chemical Engineers on October 20 on "Our Nation's Coal Resources", surveyed the changes which, during the last twenty-five years, have so profoundly affected the prosperity of the British coal industry. He pointed out the need which has been disclosed for the National Coal Survey undertaken by the Fuel Research Board, and stated that the value of the work of the Survey is becoming more obvious as it progresses. He advocates extending the Survey to examine the suitability of coals for the different industrial purposes, so as to discover where need for conservation exists. Fuel economy in utilisation and other circumstances have reduced the production of coal; but methods of mining have made great progress, and both circumstances reduce the number of mine workers. Methods of transportation and distribution have not kept pace with the improvement with the methods of mining. Sir Harold condemned the widespread ownership of private waggons as a burden on cost of distribution and advocated a unification of interests at least up to the point at which coal is to be transferred to the consumer. A rational system of grading should replace trade practice of selling by description. Intensified research on the fundamental nature of coal was urged, and indeed the factors which seem to Sir Harold most promising are more research and better organisation. The latter may be unpalatable to some individualists, but seems to be inevitable.

The Press and the Post Office

IN the course of an address to the Post Office Telegraph and Telephone Society given at King George V Hall, St. Martin's le Grand, London, on November 18, by Mr. J. H. Brebner, press officer of the Post Office, it was emphasised that the development of the Press has been closely allied to the progress of the Post Office. The Post Office can claim a great share in the development of newspapers, for from its establishment, six postal officials entitled 'clerks of the roads' were the first newsagents in Great Britain, and were solely responsible for the distribution of newspapers to all parts of the United Kingdom. These 'clerks of the roads' derived some £8,000 a year from the sale of newspapers, £6,000 of which was used by the Post Office for the payment of pensions and increases of salaries to Post Office servants who were inadequately paid. At the beginning of the nineteenth century, the private telegraph companies maintained a press bureau which supplied the newspapers with general news. The newspapers, however, desired to organise their own press agencies on the ground that they were the better judges of the news the public required. Since the telegraph companies would not give up their press bureau, the newspaper proprietors joined the growing agitation for the nationalisation of the telegraph system. The Electric Telegraphs Bill was passed in 1868, and the State accordingly acquired the telegraphs. A special 'News Division' was created at the Central Telegraph Office, London, and was maintained until 1930, when the extended use of the telephone by the Press, and the leased telegraph lines to press agencies and newspapers, rendered this section with its special press wires unnecessary. The Press has taken full advantage of each step in the progress of communications brought about by the Post Office, and the rapid development of the telephone service, since its acquisition by the State in 1912, has enabled the speedier transmission of news not only from all parts of Great Britain, but also to and from all parts of the world.

Imperial Chemical Industries, Ltd.

MR. JUSTICE EVE has allowed the petition of Imperial Chemical Industries, Ltd., to confirm a

reduction of capital from £95,000,000 to £89,565,859, the petition being opposed by a committee representing more than 13,000 holders of Deferred shares. In evidence, Sir Albert Wyon, chartered accountant, agreed that the company is spending large sums of money on research which have yielded valuable returns. These returns appear in the accounts in the shape of increased revenue. In this connexion, it is of interest to recall that, when this great combine was formed, NATURE, in a leading article (January 29, 1927, p. 149), stressed its importance from the point of view of scientific research: "Of special interest, fully recognised by the promoters of the trust, is the question whether it will be possible to improve methods and results in scientific research. The record of the constituent companies in this respect is creditable enough, and the work they accomplished during the War earned the gratitude of the nation. But combination must tend towards greater economy and greater efficiency."

Cornish Engines Preservation Fund

CORNWALL occupies a unique place in the industrial history of Great Britain, owing to its contributions to the advancement of mining and the development of the steam engine. The natural pride Cornishmen take in the achievements of the inventors and engineers of the county has found expression in various ways, and a scheme has now been set on foot for preserving, before it is too late, some of the few remaining Cornish beam engines. At a meeting held at Murdock House, Redruth, on October 15, a committee was formed to further the scheme, and an appeal has been made for funds for the purchase of a winding engine at Levant Mine, designed nearly a century ago by Francis Mitchell, and probably constructed at Copperhouse Foundry, Hayle. The engine, which is of the beam type, has a cylinder 24 in. in diameter with a stroke of 4 ft. As the mine, after a life of 110 years, has been closed down, the engine can be purchased at scrap value and arrangement can be made for its preservation *in situ* with a right of way to it, the total sum required for the purchase of the engine, repairs to the engine house and for maintenance being estimated at £300. The honorary secretaries to the committee are Mr. W. T. Hooper, of Falmouth Observatory, and Mr. W. A. Michell, Couch Lane, Redruth, while the honorary treasurer is Mr. H. Michell, of Barclays Bank, Falmouth, to whom subscriptions should be sent.

Quarterly List of Scientific Books

THE Association of Special Libraries and Information Bureaux, 16 Russell Square, London, W.C.1, has recently issued a book list which is the first of a series of quarterly recommendations of recently published scientific and technical books (10*s*. 6*d*. a year for non-members). The main object of the list is to provide public and other libraries with a selected list of recent scientific and technical books, and the list has been compiled with the assistance of more than sixty specialist organisations which are able to assess the relative merits of new publications in their own fields. Only books in the English language, and, with few exceptions, those published in the last six months, have been included. No attempt has been made to introduce detailed classification, the books being listed under broad main headings, such as General Science and Technology; Chemistry and Chemical Technology; Physics; Metallurgy; Medicine, Public Health and Nutrition; Communications and Transport, etc. The books are further sub-divided into those suitable for general readers, books of an intermediate character or suitable as textbooks for students, advanced or highly technical books, and dictionaries, directories or encyclopædias and the like. The lists should thus be of real value to specialist, as well as to public, librarians, in dealing with the difficult problem of book selection, particularly in fields of which the librarian himself has no special knowledge.

Maimonides

DR. M. GASTER delivered a lecture on "Maimonides and his Works" at a meeting on November 14 of the Royal Asiatic Society in conjunction with the Society for Old Testament Study. He said that Maimonides was a man of strong faith which deeply influenced his activity. Fully conversant with the Hebrew and Arabic literature of the time, he displayed a threefold activity. First, his legal activity consisted in compiling for the first time a comprehensive code of laws which has remained the basis of Judaism to this very day, and prevented it from splitting up into sects. Secondly, his medical activity was intended to prove, besides furthering and stimulating medical research, that there is no incompatibility between science and faith; indeed, that they assist one another. Thirdly, his philosophical activity was intended to reconcile the tenets of faith with philosophic speculation. He endeavoured to answer some of the fundamental problems of human life, such as the existence of God, the problem of creation, the relation between God and man, revelation, sin and evil, punishment and reward, and immortality. With slight modification, the answers which he gave retain their value even at the present time.

Sir John McLennan, K.B.E., F.R.S.

IN the obituary notice of Sir John McLennan published in NATURE of October 19 (p. 633), it was stated that he went from Toronto to Cambridge with an 1851 Exhibition Scholarship. Prof. A. S. Eve now informs us that this statement is not correct. Dr. E. F. Burton, who succeeded Sir John at Toronto, has written: "Although most of the men who were at the Cavendish with Dr. McLennan held 1851 Exhibition Scholarships, he did not have one himself. As a matter of fact, he resigned his position at Toronto in order to go abroad entirely at his own expense. It was in the nature of a gamble for him at that time as his resources were very meagre, but he realised that this was the only possible course to take if he wanted to work in what was then modern physics. He was undoubtedly moved to do this by the meeting of the British Association for the Advancement of Science in Toronto in 1897, as it was just after this that he went to England."

Midland Section of the Institute of Physics

THE second Local Section of the Institute of Physics to be formed in Great Britain was inaugurated at a meeting held at the University of Birmingham on Friday, November 15. Prof. S. W. J. Smith was elected chairman, and Dr. J. H. Mitchell, of the British Thomson-Houston Research Laboratory, local honorary secretary, from whom further details may be obtained. The inaugural lecture was given by Dr. J. D. Cockcroft, of the Cavendish Laboratory, Cambridge, who took as his subject "Recent Work on Nuclear Transmutations". It is proposed to hold the meetings of this new Section in Rugby and Leicester and possibly other towns in the Midlands during the session.

Forthcoming Eclipse of the Sun in U.S.S.R.

THE Academy of Sciences of the U.S.S.R. has issued a report ("Bulletin de la Commission pour les recherches du Soleil", 13) by Profs. Gerasimovič and Ščerbakova, dealing with the circumstances of the forthcoming total solar eclipse. The eclipse will take place on June 19, 1936, and the line of totality crosses the U.S.S.R. from the North Caucasus, over the Volga steppes, and over Siberia to the far eastern provinces. The track passes over both Omsk and Tomsk, which are of course large cities which will offer facilities to observers. In the present report, an account is given of the meteorological data which have been specially collected since 1933 at various stations along the track of totality, in order that prospective observers of the eclipse may have the best choice of stations likely to enjoy clear weather on the day of the eclipse.

Astronomical Spectrography

MESSRS. HILGER'S new catalogue of astronomical spectrographs and spectroscopes shows that this firm is maintaining its reputation for keeping abreast with the latest developments. Among the major instruments which it has recently constructed are the 3-prism spectrograph for the 36-in. reflector at the Royal Observatory, Edinburgh, and the spectrograph for the 74-in. reflector at Toronto. The first of these follows the general design of that at the Dominion Observatory, Vancouver, but contains many improvements; the second is designed for radial velocity work with a single prism and has a special mounting designed to reduce flexure to a minimum. The firm has also made a slitless spectrograph for the Royal Observatory, Greenwich, following a design of Mr. C. R. Davidson. Messrs. Hilger now offer as standard productions a spectroscope for observing solar prominences designed by Mr. J. Evershed, and a direct-vision constant deviation monochromator recently designed by Prof. H. H. Plaskett.

Announcements

PROF. F. G. DONNAN, professor of chemistry in the University of London and director of the Chemical Laboratories, University College, London, has been elected a foreign member of the Division for Chemistry of the Royal Physiographical Society of Lund (Sweden).

DR. C. E. K. MEES, vice-president in charge of research and development in the Eastman Kodak Co., Rochester, U.S.A., will deliver six Christmas Lectures "adapted to a juvenile auditory" at the Royal Institution on Saturdays, Tuesdays and Thursdays, commencing on December 28. The subject of Dr. Mees's lectures will be "Photography". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

A DISCUSSION on "Ice Ages", arranged by the Royal Meteorological Society and the Royal Astronomical Society, will be held on January 31 at 4.30 in the rooms of the Royal Astronomical Society, Burlington House, London, W.1. The discussion will be opened by Sir George Simpson.

THE Empire's Airway Exhibition at the Science Museum, South Kensington, organised by Imperial Airways, Ltd., will be opened by the Secretary of State for Air in the lecture theatre of the Museum at 11 a.m. on Thursday, December 5. The chair will be taken by Sir Eric Geddes.

THE Exhibition of Kinematography at the Royal Photographic Society, 35 Russell Square, W.C.1, is to remain open to the public until Saturday, November 30. The exhibition is mainly devoted to 'stills' from films. Some very fine photography is shown. A certain amount of apparatus is shown, notably that for recording and reproducing sound with 16 mm. picture film.

THE National Trust has accepted from the Viscountess Rhondda and the Dowager Viscountess Rhondda some 2,130 acres of the Sugar Loaf, just north of Abergavenny. This magnificent hill, which is well known in South Wales and Monmouth, is at the south end of the Black Mountains and rises to a height of nearly 2,000 feet.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A technical officer, an assistant (grade II) and assistants (grade III) for work in wireless equipment at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Nov. 29).

A University lecturer and a University demonstrator in biochemistry in the University of Cambridge—Sir F. G. Hopkins, Sir William Dunn Institute of Biochemistry, Cambridge (Dec. 7).

A research assistant to the Animal Diseases Research Association—The Secretary, Moredun Institute, Gilmerton, Midlothian (Dec. 20).

A Jacksonian professor of natural philosophy in the University of Cambridge—The Vice-Chancellor (Dec. 31).

A head of the silk section of the British Cotton Industry Research Association—Dr. R. H. Pickard, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 837.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Intensity Variations in the Channel of the Return Lightning Stroke

PHOTOGRAPHY of lightning strokes with the Boys camera has shown that each separate stroke is of a dual nature, consisting of a leader and a return portion. It has been shown that the return stroke travels from ground to cloud, passing outwards along the branches when it reaches branching points of the leader. The charge on the leader branches passes in this manner to ground. It has also been shown that there is a marked diminution in the intensity of the light emitted from the main channel after the return stroke has passed a prominent branch.

The photographs also permit of the study of the manner in which the intensity at any point in the channel varies with time. It is found that this intensity at the ground end of the channel fluctuates in such a manner as to indicate a series of component discharges, all apparently passing upwards. A maximum number of six such components in the return stroke has been observed, but the components of high order are weak and not always clearly seen.

The time intervals between successive component discharges are indicated in the following table:

Component	1	2	3	4	5	6
Separation from first appearance of luminosity in return channel (microseconds)	0	7 to 75	37 to 370	110 to 580	510 to 2,100	815
Cases observed		25	21	7	3	1

The ratio of the intensities of the different components has been obtained by photometric analysis of photographs specially taken with this purpose in view. Component 2 is of the same order of intensity as component 1. In a few cases it is found that at a point above a prominent branch it is actually more intense than component 1. Between component 1 and 2 the luminosity of the channel falls to less than half its previous value. If the intensity of component 1 is taken as unity, that of component 3 is of the order of 1/10 and that of component 4 of the order of 1/200. The subsequent components are too feeble for a satisfactory determination of their intensities.

There is some evidence that the second, and sometimes also the third, component is related to the existence of the charge distributed along the branches. In a number of cases the time intervals between 1 and 2 is of the same order as that required for 1 to reach the start of a prominent branch. Component 2 thus starts at the moment that this branch charge is beginning to disappear, suggesting that it is associated with the induced charge bound on the surface of the earth beneath the branch.

Where prominent branches do not exist, as in the case of strokes after the first, the second component in the return portion does not start until the first has reached the cloud.

The influence of these components upon the waveform of the atmospheric radiated from a lightning flash is being investigated.

Our thanks are due to the Lightning Research Committee of the South African Institute of Electrical Engineers for permission to publish this report.

D. J. MALAN.
B. F. J. SCHONLAND.
University of Cape Town.
H. COLLENS.
Victoria Falls and Transvaal Power Co.,
Johannesburg.

Radioactivity of some Rare Earths induced by Neutron Bombardment*

WE have studied the radioactivity produced by bombardment with slow neutrons in those elements of the rare earth group where the results of other workers are not in agreement.

The results are summarised below.

Compound	Half-period	Quantity used	Initial activity
Neodymium oxide	35 min. ± 5 min.	2 gm.	8 impulses per min.
Gadolinium oxalate	6·4 hr. ±0·3 hr	14 gm.	16 " "
Dysprosium oxalate	2 5 hr. ±0·1 hr.	1 gm.	strong " "
Erbium oxide	5·8 min. ±0·2 min	25 gm.	6 impulses per min.
	2 7 hr. ±0·2 hr	25 gm.	very strong
Holmium oxide	2 6 hr.	0 01 gm.	very weak
Lutecium oxalate	3 6 hr. ±0 4 hr.	1 gm.	35 impulses per min.

The source of neutrons consisted of 500 mgm. of radium intimately mixed with 2 gm. of beryllium. The irradiation was carried out inside a block of paraffin wax 30 cm. high and 30 cm. in diameter.

The half-period of dysprosium and the long period of erbium were determined by means of an ionisation chamber and quadrant electrometer; this is a convenient method where strong activities of fairly slow decay are concerned. The remaining half-periods were found by means of a Geiger-Muller β-ray counter, with aluminium walls 0·2 mm. thick.

It was not possible to compare accurately the relative intensities of excitation, on account of the differences in the quantities and geometrical arrangements of the specimens of the rare earths. Nevertheless, an idea of the relative intensities can be gained from the additional information given in the table.

The half-period of 6·4 hr. obtained for gadolinium is in fair agreement with the value 8 hr. reported by Hevesy and Hilde Levi[1]. The half-period, 3·6 hr., of lutecium is close to the value 4 hr. given by Marsh and Sugden[2]. The short period of erbium reported by the latter authors has been carefully investigated

* Sir John McLennan died on October 9, but the observations here recorded were made with the joint author, Mr. W. H. Rann.—Editor, NATURE.

and found to be 5·8 min. The 2·6-hr. period observed in the case of erbium is probably due to traces of the strongly active element holmium, as was suggested by Marsh and Sugden[2].

Our thanks are due to the Union Minière du Haut Katanga for the loan of the radium used, and also to Messrs. Adam Hilger, Ltd., for the loan of a specimen of neodymium oxide.

J. C. McLENNAN.
W. H. RANN.

Radium Beam Therapy Research
at the Radium Institute,
16 Ridinghouse Street,
London, W.1.

[1] Hevesy and Hilde Levi, NATURE, 136, 103, July 20, 1935.
[2] Marsh and Sugden, NATURE, 136, 102, July 20, 1935.

'Extra' Electron Diffraction Rings

DR. G. I. FINCH and A. G. QUARRELL[1] have reported many 'extra' rings in electron diffraction patterns from thin metal foils containing preferentially oriented crystals. At first they attributed these to diffraction from two-dimensional gratings made up of the atoms in the crystallographic faces through which electrons might leave the foil. In a later comprehensive paper, Finch, Quarrell and Wilman[2] have stated that the extra rings do not appear unless the metal foil is contaminated; the earlier explanation has been abandoned. In this later paper are given, however, the results of the calculations concerning diffraction by atoms in exit faces. This note is concerned solely with the results of such calculations.

It is worth pointing out that the extra diffraction rings cannot be explained in the manner first proposed. The case is one of face-centred cubic crystals oriented with a (110) direction parallel to the primary beam and to the surface normal. It was first proposed[1] that atoms in (111) and (120) exit faces were responsible for the extra diffraction rings. In the later paper[2], the exit faces were described as (110) and (120). The previous designation of an exit plane as (111) was clearly an oversight or typographical error, as it can be shown that a (111) plane of atoms would give rise to all the Debye-Scherrer rings for the oriented crystals, and to no extra rings.

In regard to scattering by atoms in a (120) plane when the primary beam direction is (110), one can show that there will result diffraction cones about the primary beam direction, the semi-apex angles of which are approximately equal to:

$$\frac{\lambda}{a_0} \sqrt{\frac{1}{9}(11\,h_1^2 - 8\,h_1\,h_2 + 8\,h_2^2)}.$$

Here λ represents the wave-length, a_0 the length of the edge of the unit cube of the face-centred structure, and h_1 and h_2 are any positive or negative whole numbers. The radical has the following series of values: 0·94; 1·11; $\sqrt{3}$; 1·89; $\sqrt{4}$; etc. The integers 3 and 4 correspond, of course, to the first two Debye-Scherrer rings. The extra rings corresponding to the other values are not those calculated by Finch, Quarrell and Wilman[2], and they do not agree with the extra rings observed.

L. H. GERMER.

Bell Telephone Laboratories,
New York, N.Y.
Sept. 12.

[1] NATURE, 135, 183; 1935.
[2] *Trans. Faraday Soc.*, 31, 1074; September 1935.

THE observed ring radii are given in the table below, col. 1, and the ring radii we attributed to scattering from a (110) exit face [(111) is obviously an error] in col. 2. In cols. 3, 4 and 5 are set forth the values calculated by Finch, Quarrell and Wilman, and by Germer using his approximate and accurate expressions respectively.

Table

1	2	3	4	5
0·99	1·00	0·98	0·94	0·9407
1·10	—	1·11	1 11	1·105
—	—	1·12	—	1·107
1·40	1·41	—	—	—
1·65	—	—	—	—
1·73	1·73	1·73	1·73	1·727
—	—	—	—	1·729
1·76	—	1·76	—	—
1·78	—	1·78	—	—
—	—	—	1·89	1 877
—	—	1·95	—	—
2·00	2·00	2 00	2·00	2·001

Germer's results are the more accurate; we evidently placed too much reliance on four-figure tables in working out results involving small angles. We had, however, to consider more than one plane and so preferred the more direct method of calculation indicated in our paper.

I may add that, even before the experimental discovery of the real origin of 'extra' rings, the 'exit face' idea had lost much in attraction when it was realised that any and every 'extra' ring could be accounted for by postulating a suitable exit face.

G. I. FINCH.

Imperial College of Science and Technology,
London, S.W.7.

Pigments of the Bull Frog Retina

THE substances and processes found in the retina and pigment epithelium of the bull frog, *Rana catesbiana*, are identical with those in species of frogs

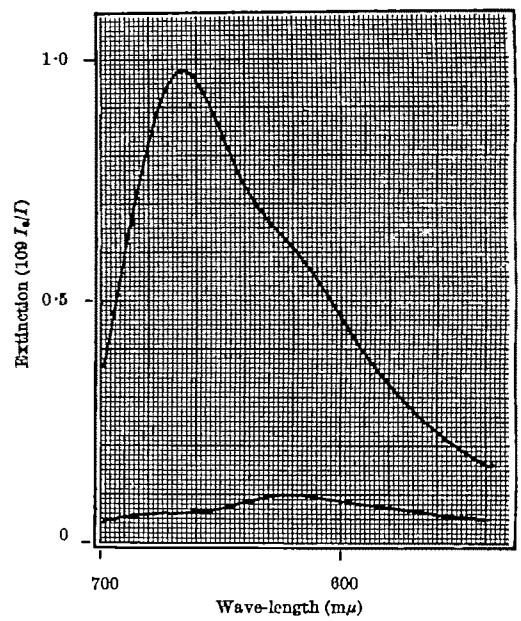


FIG. 1.

previously examined[1]. The retina contains varying amounts of the carotenoids retinene and vitamin A. Retinene is yellow, and when mixed with antimony trichloride reagent yields a sharp absorption band at

662–666 mμ. (In the hand spectroscope this band has invariably appeared to be at about 655 mμ, the position originally given.) Vitamin A is colourless in comparable concentrations, and in the antimony trichloride test yields a band at 612–615 mμ (crude extracts).

Dark-adapted retinas contain only a trace of vitamin A, which can be extracted in the dark with benzine without injury to the visual purple (Fig. 1, lower curve*). Afterwards, the same retinas may be re-extracted with benzine in bright light. Light bleaches visual purple to 'visual yellow', after which benzine readily extracts a large quantity of retinene (Fig. 1, upper curve). The destruction of visual purple in the dark with chloroform also liberates retinene (Fig. 2, upper series). Visual yellow appears

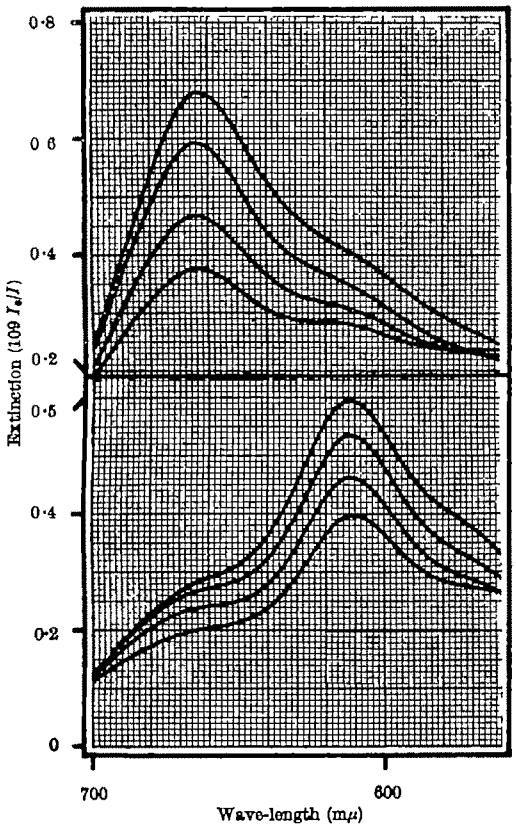
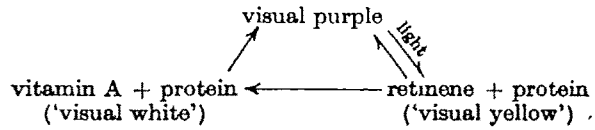


FIG. 2.

to be simply free retinene, liberated by light—or by chemical treatment—in the destruction of visual purple. (At the time of writing the previous report, I believed retinene to be bound complexly in visual yellow as it is in visual purple, a legitimate interpretation of the data then available.)

The retinene of bleached ('visual yellow') retinas is converted quantitatively to vitamin A by a thermal process which occupies about an hour in either light or darkness at 25° C. During this interval, the retinas fade from yellow to colourlessness. The lower curves of Fig. 2 show this change. They were obtained with retinas symmetrical with those which yielded the upper series, but had been bleached in bright light and allowed to fade for about an hour at 22° C. before being extracted.

In the isolated retina, vitamin A is the final product of the bleaching and fading reactions. In the intact eye, however, the vitamin is resynthesised to visual purple. This process completes the visual cycle, represented partly by the scheme:



Isolated bull frog retinas which have been bleached and wholly faded contain about 2·3 γ per eye of vitamin A. Retinas light-adapted *in vivo* contain only about 0·8 γ of the vitamin. This loss of vitamin A in the active retina probably accounts for the dependence of the visual purple system in some animals upon a continuous supply of vitamin A in the diet.

The combined pigment epithelium and choroid layer of the bull frog eye contain about 2 γ of xanthophyll and about 9 γ of vitamin A, at least 80 per cent of which are located in the pigment epithelium alone. An incomplete extract of these tissues also contained about 1·3 γ per eye of flavine, similar to that found by von Euler and Adler[2] in the eyes of several mammals and fishes.

Details of this work will appear in the *Journal of General Physiology*.

GEORGE WALD.

Biological Laboratories,
Harvard University,
Cambridge, Mass.

[1] G. Wald, NATURE, 134, 65; 1934. *J. Gen. Physiol.*, 19, 1935–36, in press.
[2] H. von Euler and E. Adler, *Z. physiol. Chem.*, 223, 105; 228, 1; 1934.

* Figs. 1 and 2 show spectra of antimony trichloride reactions with bull frog retinal extracts. They were measured at the Massachusetts Institute of Technology with a recording photoelectric spectrophotometer (Hardy, A. C., *J. Opt. Soc. Amer.*, 25, 306; 1935). The curves were drawn by the instrument, and have been merely mounted and photographed. The lower curve of Fig. 1 was drawn 5mμ too high in wave-length, due to a fault in calibration which was corrected before the upper curve was recorded. Each series of spectra in Fig. 2 presents successive measurements of a single antimony trichloride test, and allows the fading of the blue colour produced in this reaction.

Statistical Tests

THE discussion in these columns which has followed Mr. Buchanan-Wollaston's letter in NATURE of August 3 tempts me, as yet a third member of University College, London, to try to express my views on an interesting, but evidently controversial, subject. Others besides myself have, I know, welcomed a reminder from the author of the "Grammar of Science" that, in the fullest sense of the terms, we are concerned not with the truth or falsehood of a hypothesis, but with the extent to which it graduates our observations of Nature. I fancy that if Mr. Buchanan-Wollaston were to consider specific examples he might find it a little difficult to substantiate the statement, made in his letter in NATURE of November 2, that hypothetical frequency distributions are of two radically different kinds. If I understand him correctly, he suggests, for example, that the Normal curve sometimes falls into one category, sometimes into the other. But can he really maintain that this distribution curve with its infinite limits for the variable is ever anything but a graduation formula?

Yet I agree that it is difficult to speak of all statistical analysis in terms of graduation. In

scientific research as well as in the affairs of every-day life, we are continually faced with situations where a decision must be made on incomplete data determining which of two alternative courses of action is to be followed. Since we may decide on course *A* when, with more complete information, we should have followed course *B*, and vice versa, two different faulty decisions may be made having very different consequences. A practical example is that of the large-scale purchaser of a certain mass-produced article, who has to decide after the inspection of a sample of limited size whether or not to accept a consignment of several hundreds of these articles.

In a very similar manner in scientific investigation a hypothesis is formulated and tested on observed phenomena. The scientific worker cannot tell whether the hypothesis is true or false, but if his investigation is to continue he must either accept the hypothesis provisionally as useful to him, or reject it as of no use and seek for an alternative hypothesis. Either decision may be one which he would not have made had much fuller information been available at the time, and in this sense may again be spoken of as liable to error.

The tools of statistical analysis have been fashioned to help the experimenter in this process of testing a hypothesis, and, as with all tools, their parts and uses must be described in a technical terminology. Further, as in other branches of applied mathematics, it is necessary to construct a precise but simplified model which we believe will represent the world that we observe with sufficient accuracy to provide us with useful results. Here there is freedom of choice.

Let me illustrate one method of approach by taking the case of a biochemist who is instructed to investigate, by experiments carried out on rabbits, whether there is any difference in regard to a certain reaction, between a new and cheaper form of insulin and an older standard form. Owing to the different response of individual rabbits even to the same treatment, it is the mean difference between effects that must be considered. Further, while no statistical test applied to a limited number of observations can be expected to detect very small differences, the test to be used should be one which is as sensitive as possible to the existence of a real difference, and yet will be unlikely to suggest a difference which is not there.

On the assumption that some decision, whether provisional or final, regarding the adoption of the cheaper insulin is to be based on the result of the experiment, the biochemist will probably report either that (*a*) there appears to be a difference, or that (*b*) he can detect no significant difference. In a purely formal sense, it is convenient to speak of these statements, leading to different decisions regarding further action, as (*a*) that of rejecting the statistical hypothesis that there is no difference in mean effect, and (*b*) that of accepting this hypothesis, and this is the sense in which these terms are used below. Further, it follows that statement (*a*) may have been made when more extensive experiments would show that the apparent difference was purely a chance sampling result, statement (*b*) when such experiments would establish a real difference. Thus again in formal language it is convenient to speak of a decision based on incomplete data as liable to two types of error.

In one case a cheaper form of insulin may be put on one side, at any rate temporarily, in the belief that it is of inferior quality, where fuller experiment would have shown that this was not the case. The statistical hypothesis tested has been rejected when it is true and an error of the first kind has been made. In the second case a cheaper insulin is advocated which in fact has not the properties of the older standard. The statistical hypothesis tested has been accepted when it is not true, and an error of the second kind has been made.

In any given problem it is impossible to say whether a hypothesis is true or false, but it is possible to assess the efficiency of statistical tests by the manner which, on repeated application, they control these two forms of error. Further, it does not alter the essential features of this approach if, as Mr. Buchanan-Wollaston points out in his second letter, it may often be desirable to allow for a third verdict, that of "not proven". I have stated the problem in its simplest form, yet it will be found that very frequently the immediate decision does lie between *two* courses of action. Thus while the purchaser of mass-produced articles might make one of three decisions after inspecting a sample, namely, (*a*) reject consignment, (*b*) accept consignment, (*c*) inspect a further sample, he does in fact often make his first decision between (*b*) and (*c*) and then, if he has followed course (*c*), decide between (*a*) and (*b*).

With Prof. Fisher's objections to our method of approach, Dr. J. Neyman and I have long been familiar, but it would, I am sure, be inappropriate to enter here into a discussion with him on the place of errors in statistical theory.

E. S. PEARSON.

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London, W.C.1.

Crossing-Over and Chromosome Disjunction

BRIDGES, Anderson, Mather, Gershenson and many others have shown that there is a definite relation between crossing-over and the disjunction of chromosomes. Their work has made it evident that, during meiosis, crossover chromosomes are distributed between the daughter nuclei more regularly than non-crossover ones. However, the exact nature of this relation is still by no means clear. Darlington thinks that crossing-over is, in general, a necessary condition of regular chromosome disjunction. On the other hand, a number of general considerations as well as some recent facts obtained by Gershenson, Beadle and Sturtevant and Stone and Thomas, are opposed to such an interpretation in the case of *Drosophila*.

In order to decide the latter question, I undertook an experiment in collaboration with Miss Helene Pogossiants, in which, by using certain rearranged chromosomes, it seemed possible to obtain somewhat more conclusive results than in previous work. Crossing-over and non-disjunction were studied in females of *Drosophila melanogaster* carrying an *X*-chromosome with the *ClB* inversion and another *X*-chromosome (translocation X–IV or 'Bar-Stone'), most of the genetically active part of which was translocated to the fourth chromosome. Data on single crossing-over in the non-inverted region and the number of recovered double crossovers in the inverted region enabled us to conclude, with a high degree of certainty, that single crossing-over in the latter region (undetectable by direct methods) is very low. Possible undetected crossing-over in the

genetically inert parts of the *X*-chromosomes could influence only the disjunction of the *ClB* chromosome and the right (non-translocated) part of the other *X*-chromosome, as the left part, translocated to chromosome 4, does not carry any of the inert region of the *X*-chromosome. Non-disjunction of the left part of this *X*-chromosome and the *ClB* chromosome is much lower than would be expected if Darlington's hypothesis applies to *Drosophila*, and seems therefore to show that regular disjunction of chromosomes is not absolutely conditioned by crossing-over.

It seems clear that both crossing-over and chromosome disjunction are dependent on a third, more general factor, possibly on the intensity with which the conjugation of chromosomes takes place.

S. GERSHENSON.

Institute of Genetics,
Academy of Sciences,
Moscow.

DOBZHANSKY[1], Gershenson (above) and others have concluded that the disjunction of chromosomes does not depend directly on the occurrence of crossing-over between them, as I assume to be the case in all homozygous organisms[2]. They maintain that some "other factor" is concerned in their experiments. But these experiments have necessarily made use of hybridity, without which genetical tests are impossible; and the particular kind of hybridity (structural hybridity) they have used is bound to have a complicated effect on disjunction. It is itself the "other factor". Thus reciprocal crossing-over within two relatively inverted segments should give normal chromosomes with normal disjunction, other things being equal.

But when we consider the structure of the bivalent given by such crossing-over, we see that the disjunction expected in straightforward bivalents will not necessarily follow (Fig. 1). The pull which is to separate the paired chromatids is parallel to the plane of their association and not perpendicular to it. Resistance to separation is therefore not a certain constant minimum, but a function of the length between the two chiasmata. I have observed failure of disjunction in these circumstances in an inversion heterozygote in *Stenobothrus parallelus*. Other kinds of crossing-over in dislocated segments give rise to lagging, interlocking and irregular breakage. It is not therefore surprising that Grüneberg[3] finds the 'non-disjunction' that has previously been attributed to non-pairing and random segregation is often due to loss of both partners.

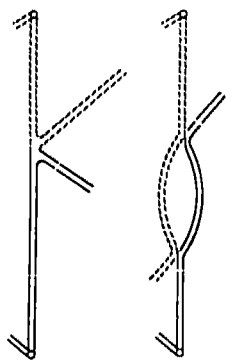

FIG. 1 The structure of bivalents with single (left) and double reciprocal crossing-over (right) between relatively inverted segments of homologous chromosomes.

This is merely one example of the special complications arising in structural hybrids. They have been described by Richardson for inversion hybrids and by myself for interchange hybrids in articles in the press[4]. They show the danger of arguing from the assumptions involved in an abstracted formal use of the terms "chromosome", "non-disjunction" and even "crossing-over" by the geneticist. They also show the difficulty the geneticist is faced with in dealing with the highly selected viable progeny of structural hybrids, a difficulty which can only be overcome by a close collaboration between those who are breeding the hybrids and those who are studying the structures found at meiosis in comparable material[3].

C. D. DARLINGTON.

John Innes Horticultural Institution,
London,
S.W.19.

[1] *Z.I.A.V.*, 64, 269–309.
[2] *J. Genet.*, 31, 185–212.
[3] *J. Genet.*, 31, 163–184.
[4] *J. Genet.*, in the press.

Induction of the Eye by a Specific Substance in the Amphibia

IT is known that in the axial mesoderm of the Amphibia, the capacity to induce individual organs varies from anterior to posterior, each organ having its 'induction field'[1]. After the discovery of inducing substances it is natural to consider whether the existence of these fields may be explained by the localised distribution of specific substances which determine their properties.

If this suggestion were found to be true in the case of any one organ, one could generalise and assume that it is true for other organs as well. The following investigation deals with the eye; if the development of this organ is determined by the presence of a specific substance, the diffusion of this substance from a dead eye must induce, in the ectoderm of an early gastrula, only eyes or eyes with the adjacent region of brain. Accordingly, optic vesicles were removed from *Axolotl* or *Triton taeniatus* in the tail-bud stage, killed by treatment with boiling water or alcohol, and implanted in the blastocœls of early gastrulæ of *T. taeniatus* or enveloped in flaps of presumptive ectoderm of that species. Eyes were induced in 100 per cent of the positive cases, either in whole embryos or in explants. In whole embryos induction was found to be independent of the level of the host. They were usually connected with a mass of brain tissue, which might be smaller than the eye; in some cases, several eyes were formed together. The eyes were normally shaped; and the retinal part of the eye was capable of inducing a lens from the host ectoderm, if it came in contact with it.

The conclusions which may be drawn from these facts are as follows: (1) The agent which induces the primary embryonic axis is not unspecific as regards the region of axis which is induced; possibly it includes a mixture of specific substances or entirely consists of such specific substances. (2) The regional differences within the primary embryonic axis are determined by the corresponding distribution of specific formative substances. (3) Polarity in the system of ectomesoderm[2] is possibly determined by a similar distribution of substances from pole to pole. The phenomenon of regulation must be accounted for by the assumption that these substances follow the principle of polar distribution, and that after a disturbance of the system the previous distribution of the substances is restored.

G. LOPASHOV.

Institute of Experimental Biology,
Woronzowo Pole 6,
Moscow 120.
Oct. 4.

[1] Holtfreter, *Joh Arch. Entw.-mech*, 127; 1933.
[2] Lopashov, G., *Biol. Zentrbl.* (in press).

First Appearance of Red-eye in the wild *Gammarus chevreuxi*, Sexton

In a letter to NATURE[1], we were able to show that heterozygosity existed in the wild stock of this species —eggs from an outside mating, hatched some days later in the laboratory, gave 2 red-eyed recessives in a brood of 11 young.

Although dredging had been carried on at frequent intervals since 1912, and heterozygosity in the wild stock had been suspected for eleven years past, this was the first definite proof obtained, and it was again noted that no red-eyed had yet been found in the open. We have now to record its first appearance. In the dredging brought in on October 22 and examined for eye colour, one *red-eyed* was found amongst 2,000 black-eyed animals.

E. W. SEXTON.
A. R. CLARK.
G. M. SPOONER.
Marine Biological Laboratory,
Plymouth.
Oct. 30.

[1] Sexton and Clark, "New Developments in *Gammarus chevreuxi*, Sexton". NATURE, 133, 27, 1934

Hyperfine Structure and the Gross Structure Analysis of the Spectrum of Doubly Ionised Antimony

THE hyperfine structure of two doublets of the spectrum Sb III has recently been investigated by me at the Reichsanstalt, Berlin. The structures were diffuse, but each line was resolved clearly as a doublet. The wave-lengths, classification[1] and the observed hyperfine structure separations in cm.$^{-1}$ are given below.

Wave-length	Classification	$\Delta\nu$
4265·09	$6s\ ^2S_{1/2} - 6p\ ^2P_{3/2}$	1·27
4591·89	$6s\ ^2S_{1/2} - 6p\ ^2P_{1/2}$	1·40
4352·16	$5s\,5p^2\ ^2S_{1/2} - 6p\ ^2P_{3/2}$	0·45
4692·91	$5s\,5p^2\ ^2S_{1/2} - 6p\ ^2P_{1/2}$	0·55

Taking the nuclear spin-moments of the two antimony isotopes as $5/2.h/2\pi$ and the ratio of their $g(I)$ factors as 1·37[2], and using the graphical method of Fisher and Goudsmit[3], the splitting factor of the $6s\ ^2S$ term for Sb^{121} could be estimated to about 0·53 ν. Applying the formulæ given by Goudsmit[4], the magnetic moment of the nucleus Sb^{121} could be calculated to be about 7·2 proton-magnetons. From my data[5] on the structure of the lines of the first spark spectrum, Goudsmit[4] has deduced a value 2·7 for the magnetic moment of Sb^{121}, compared with which the value obtained above is much too large. The reason for this is to be found in the incorrect analysis of the gross structure. If the $6s\ ^2S$ and the $5s\,5p^2\ ^2S$ terms are interchanged, the calculated value of the magnetic moment comes out to be 2·7, in quite good agreement with the value quoted above. Thus of the two ^2S terms, the deeper should arise from the configuration $5s\,5p^2$ and the higher from the configuration $5s^2\,6s$. This would assign to the $5s\,5p^2$ term a much larger splitting than that of the $6s$ term, which is not unexpected.

The two terms are very close together, their values differing only by 469 cm.$^{-1}$. The pair λλ 4352, 4693 is decidedly the stronger of the two, and it is more likely that the weaker pair should involve the double electron transition $5s\,5p^2 \leftarrow 5s^2\,6p$, and this is in accord with the suggested modification. A comparison of the values of the two terms in the isoelectronic spectra of In I, Sn II, Sb III and Se IV shows that the change suggested is quite consistent. In the corresponding case of As III, however, the pair of shorter wave-lengths is the stronger; it is therefore likely that the $5s\ ^2S$ term is deeper than $4s\,4p^2\ ^2S$. Here, too, the two terms are close together and a study of the structures of the lines in question would decide the correct configuration.

It is very interesting to note that the small energy changes in the radiation due to the interaction of the nuclear magnet with the extra-nuclear electrons helps to decide the electron configuration involved in a particular transition, and this is particularly useful when the terms are close together and it is otherwise difficult to assign the correct electronic configuration.

Details of the above investigation will be published elsewhere.

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Sept. 10.

[1] Lang, *Phys. Rev.*, 35, 445; 1930.
[2] Tolansky, *Proc. Roy. Soc.*, A, 146, 182; 1934.
[3] Fisher and Goudsmit, *Phys. Rev.*, 137, 1059, 1931.
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[5] Badami, *Z. Phys.*, 79, 206; 1932.

Occurrence of the Reversed Absorption Edges of the Long Wave-Lengths of X-Rays

IN the region of the long wave-lengths of X-rays, there are difficulties in obtaining absorption edges, for the intensity of the continuous ground of the X-radiation is very small. A further difficulty is in the classification of some of these edges, as, for example, the M_V-edges. Also it is well known that the calculated energy values of the M_V-edges for higher elements do not agree with the measured values[1], and it is not possible to extrapolate or to say what differences can be expected in this region. We have found some reversed edges in this region[2], which must be classified as M-edges of silver and bromine. The classification of these edges requires a detailed discussion for which space cannot be afforded in NATURE. It may, however, be of interest to give the results and the difficulties in obtaining a L_{III}-reversed edge.

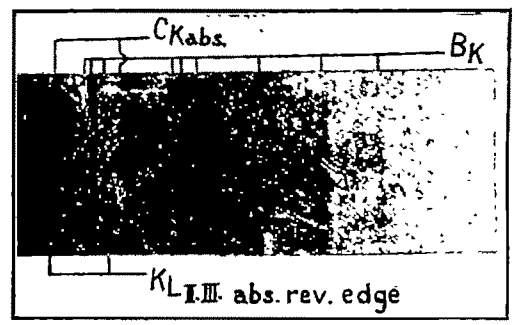

FIG. 1.

Two years ago, we obtained a reversed absorption edge of the wave-length λ = 42·1 A., which corresponds to ν/R = 21·6. But on some plates, made with different anticathodes, this absorption has been either displaced, or appeared as a white absorption line or entirely disappeared. We have now found

that the above-mentioned phenomena were caused by occasional overlapping of emission lines, and the said overlapping could not be recognised on account of the lines in the region of long wave-lengths being broad and the dispersion small. It is now evident that this edge is only due to the emulsion of different photographic plates, and it belongs to the $L_{II, III}$-absorption edge of K (from potassium bromide), giving for L_{III} the calculated value $\nu/R = 21 \cdot 5$. One of the plates of this edge, made on Eastman-Kodak plate, shows (in the first and second orders) a clear potassium edge appearing as a broad white line. The appearance of this edge as a white line is caused through the simultaneous occurrence of the normal edge of carbon with the said reversed edge, as seen in Fig. 1. The value given above has been measured from other plates with greater dispersion, with copper and tungsten anticathodes, giving sharper reference lines.

With these results, obtained with the low tension ionic tube[3], the existence of the reversed absorption edges in this region is verified.

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[1] M. Siegbahn, *Z. Phys.*, **67**, 567; 1931.
[2] V. Dolejšek and B. Janček, NATURE, **132**, 443; 1933.
[3] V. Dolejšek and V. Kunzl, *Č.J.M.F.*, **6**, 242; 1932. *Z. Phys.*, **74**, 565; 1932.

Reactions of Sulphuryl Diamide (Sulphamide)

APART from salt formation (for example, work by F. G. Mann in 1933) only two reactions of this substance have been recorded. Traube and Reubke (1923) obtained a 5 per cent yield of a condensation product with benzaldehyde, and in 1933 I showed (with Mr. A. E. Battye) that sulphamide readily condenses with formaldehyde to give a resin-like body from which a tetramethylol derivative may be isolated.

I have now found a third 'organic' reaction for this substance, which again exhibits its great similarity with urea. If xanthydrol in alcohol is added to a solution of sulphamide in acetic acid and water, after some time, beautiful lustrous crystals of dixanthyl sulphamide, m.p. 182°–4° C., are obtained. Condensation products have also been obtained with xanthydrol and

p-aminobenzene sulphonamide,	m.p. 209°
m-benzene disulphonamide,	m.p. 170°
p-toluene sulphonamide,	m.p. 198°.

Details will be published elsewhere of this general reaction for the sulphamides and sulphonamides, which in certain cases may be conveniently used for their estimation.

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Points from Foregoing Letters

ULTRA-RAPID photography has shown that lightning strokes consist of a 'leader' from cloud to earth and a return stroke in the opposite direction. From fluctuations in the luminosity of the return stroke at the ground end, D. J. Malan, Dr. B. F. J. Schonland and H. Collens infer that the return stroke is made up of several component discharges, the intensity and time separation of which in micro-seconds they have measured. The authors are now investigating the influence of these components upon the wave-form of atmospherics radiated by the lightning flashes.

Some experiments by the late Sir John McLennan and Mr. W. H. Rann on the radioactivity produced by neutron bombardment of certain rare earths are described. They confirm earlier results of Hevesy and Levi and of Sugden and Marsh.

Finch and Quarrell suggested some time ago that the 'extra' rings obtained in electron diffraction experiments with metal foils (containing oriented crystals) were due to two-dimensional refractions at the exit crystal faces. Dr. L. H. Germer submits calculations showing that this cannot be the case. Dr. G. I. Finch agrees with Dr. Germer's findings and points out that they are consistent with the new interpretation put forward by Finch, Quarrell and Wilman, namely, that the 'extra' rings are due to surface contamination.

G. Wald finds in the light-adapted retina of the bull-frog, as in the case of other species of frogs, two substances chemically related to carotene, the yellow pigment of carrots: vitamin A (visual white), and retinene (visual yellow). In the dark, the yellow retinene changes to visual purple. Extracted retinene is transformed on standing into vitamin A. In the intact eye vitamin A is resynthesised to visual purple.

Prof. E. S. Pearson, continuing a discussion on statistical tests, contends that all hypothetical frequency distributions are merely graduation formulæ. We are never concerned with whether a hypothesis be true or false, but only with the extent to which it graduates our experience of Nature. But nevertheless, the efficiency of statistical tests can be assessed by the manner in which, on repeated application, they control certain errors of practice.

During the process of meiosis, the chromosomes carrying the inheritable characters from two parent nuclei join together, exchange certain portions, and then split (disjunction). Re-arrangement of certain portions (crossing-over) may occur. Darlington has stated that crossing-over is a necessary condition of regular chromosome splitting. Dr. S. Gershenson reports experiments with female fruit flies from which it appears that this is not the case. Dr. C. D. Darlington replies that this hypothesis applies to normal (homozygous) organisms and not to hybrids such as were necessarily used by Gershenson.

One or more eyes have been experimentally produced by G. Lopashov in *Triton tæniatus* by implanting into the blastocœls of early gastrula stage, dead optic vesicles from other specimens of *T. tæniatus* or of axolotl.

Using the known value of the magnetic moment of the nucleus Sb^{121}, a study by Dr. J. S. Badami of the hyperfine structure of the lines of the spectrum of the doubly ionised antimony atom has led to a modification of the gross-structure analysis of the spectrum Sb III.

Research Items

Pithecanthropus and the Gibbon

DR. EUGÈNE DUBOIS, having shown on the evidence of five thigh bones both the organic differentiation of *Pithecanthropus erectus* and at the same time its close affinity with the gibbon, has now considered the trend of the evidence derived from the volume of its brain, much too large for an anthropomorphous ape, very small in comparison with the average of that of a man (*Proc. Akad. Wet. Amsterdam*, 38, No. 6). Study of the laws regulating the size of the brain in mammals points to a relationship between its volume and the size of the body. In every case the functional degree can be expressed by the 'co-efficient of cephalisation' (or 'factor of animal organisation') which appears to arrange the mammal groups in a systematic order agreeing with what we know of their animal organisation. This has been found to hold good for birds, reptiles and fishes, and vertebrates generally. It was found that this law applied functionally to the psychencephalon, chiefly the cerebral hemispheres. Further, it has been found that in not a few cases of closely related mammals the co-efficient of cephalisation increases by doubling and redoubling, that is, in a geometric progression with a ratio of 2. This law of the autonomic phylogenetic progression of the psychencephalon is of direct significance for the taxonomy of *Pithecanthropus*. It is possible to arrange all the existing groups of mammals in a geometrical series with progressive 'co-efficients of cephalisation' in which there are no gaps, with one exception—that between man and the anthropomorphous apes. This marks the place of *Pithecanthropus erectus*. By a calculation on this basis, the probable weight of the body is shown to be 104 kgm. That probability is in favour of the accuracy of this figure is argued from the chief dimensions of the femur, on the analogy of similar organisms, for example, the gibbon. The gibbon resemblance also appears in the place of the gravitation centre of the head before the condyles, and also in the general form of the skull. The mandible resembles that of the gibbon and shows that *Pithecanthropus* was devoid of the power of human speech.

Rural Population in the United States

AN instructive series of investigations bearing on the character and movements of the rural population of New York State are being carried on by the Cornell University Agricultural Station, Ithaca, N.Y. A study of the activities and interest of the young women of the open country and villagers of Genesee County, N.Y., in 1934, has now been followed by a similar investigation among young men ("Interests, Activities and Problems of Rural Young Folk. (2) Men 15 to 29 Years of Age." By W. A. Anderson and Willis Kerns. *Bull.* 631. Cornell Univ. Agric. Station). Data were obtained from 307 young men, of whom 54 per cent were the sons of farmers and 33 per cent of skilled or unskilled labourers. Their interests were found to be mainly social-recreational and economic-vocational. The evidence collected pointed very definitely to the need for vocational guidance. For there was a very distinct urge towards a skilled trade as a life-work, but very little evidence of any definite plan to give it effect. A preponderating number expressed a preference for rural life and farm work. In this connexion it is significant that a previous inquiry ("Mobility of Rural Families" by W. A. Anderson. *Bull.* 623) showed that while agriculture in New York State is carried forward by the same type of population with only slight geographical shifting, giving the rural areas a stable social organisation, and while farming shows a greater tendency to be handed on from father to children than any other major occupation, it appears that this industry can employ only thirty per cent of the children reared in farm families, although previously the estimate had been placed so high as fifty per cent.

Breeding Habits of Common Catfish

A STUDY of the reproductive habits of the common catfish (*Ameiurus nebulosus*), by C. M. Breder, shows that they give the clue to some peculiarities developed in other nematognaths (*Zoologica*, 19, No. 4; 1935). Thus the oral gestation of the Ariidae seems to be foreshadowed by the way in which the common catfish uses its mouth for churning the eggs about, taking them into its mouth and ejecting them violently; the adhesion of the eggs to the ventral surface of the Aspredinidae is suggested by the position of the catfish during incubation, when it lies upon the egg-cluster; and the special use of the ventral fins in working over the developing eggs initiates a habit which may have culminated in the use of the ventral fins as an inseminating basket, as in *Corydoras*. The common catfish may spawn twice in a season after a temperature of 21° C. has been reached, and the young fish, as well as the eggs, are guarded by the parents during their development.

Ecology of a Salt-Marsh

IN a paper on the ecology of a salt-marsh in Aberlady Bay on the Firth of Forth, fifteen miles east of Edinburgh, Edith A. T. Nicol (*J. Mar. Biol. Assoc.*, 20, 1935) records that *Protohydra leuckarti* was common at certain times in some of the pools. It was present in May and June 1931 in large numbers in one pool and was still abundant in October, but died out during the winter and was not rediscovered until the summer of 1933, when it appeared in an adjacent pool. The uneven distribution and the difficulty of seeing this animal probably account for the few records of its occurrence in Britain. It has been previously recorded by Hickson from Southampton Water and from near Plymouth but, in addition to finding it in the Firth of Forth, Dr. Nicol found it in large numbers, in one pool only, in a small marsh at Torridon in Western Ross. She records that in one pool in Aberlady Bay, in June, there were 8,890 young *Nereis* in an area of one square foot of mud and in another pool 3,672 larvæ of *Chironomus aprilinus* were present in a square foot, and on the bare mud of the banks of the stream which runs through the marsh *Hydrobia ulvæ* was present to the number of 3,020 per square foot. Detailed observations were made on the conditions, salinity, oxygen-content, alkali-reserve, hydrogen ion concentration and temperature, under which the

animals in the pools were living, and the relationship of the conditions—of which the most difficult for the animals is that of changing salinity—to the life of the animals is discussed in connexion with recent work on the physiology of certain inhabitants of brackish water.

Vernalisation of Seeds

THE announcement by Lyssenko, a few years ago, of the process of vernalisation of seeds, raised very considerable hopes of enhanced yields and easier cultivation among the community of gardeners. Storage of the seed for certain periods at low temperatures was the main feature of the discovery. A short note in the *Gardeners' Chronicle* of October 19, by Mr. S. Burr and Miss D. M. Turner, throws further, but unfavourable, light upon the process. Tomato seed vernalised between 1° and 3° C. for periods ranging from 7 to 44 days was not equal, either in vigour of germination or in subsequent yield, to untreated seed. Normal seed germinated 97 per cent, whereas vernalisation for 44 days gave 20 per cent. Less extreme, though quite significant, were the yields—plants grown from seed vernalised 32 days yielded only 72 per cent of the untreated group. Cucumbers gave similar results.

New Virus Diseases of Tomato

THE number of virus diseases of plants increases at a really astonishing rate. Fifteen years ago, the well-authenticated virus diseases might have been enumerated without using two figures, but now they occur in hundreds. Dr. Kenneth Smith, of the Potato Virus Research Station, Cambridge, announces the discovery of three new virus diseases of the tomato (*J. Roy. Hort. Soc.*, 60, 448–451, Oct. 1935). One malady causes cessation of growth, yellowing and purpling of the lower leaves, and malformation of the whole plant. The second is referred to as the 'distorting virus', and justifies its title by causing severe malformation of the leaves. Many fine leaflets appear instead of the usual well-favoured foliage, and the terminal leaflet frequently becomes a tendril. Symptoms of the mosaic type distinguish the third disease, which, however, differs slightly from the ordinary tomato mosaic by producing a greyness upon the leaf, with bandings of yellow and green. The two latter diseases may have been brought to Great Britain by the importation of smoking tobacco.

Transmutation by Deuterons

E. O. LAWRENCE, E. McMillan and R. L. Thornton (*Phys. Rev.*, Sept. 15) have studied the yield of induced radioactivity in a number of elements, activated by deuteron bombardment, as a function of the energy of the bombarding beam. Sodium, aluminium, silicon and copper all give β-radioactive products, probably by reactions typified by $Na^{23} + H^2 \rightarrow Na^{24} + H^1$. The yield increases with increasing deuteron energy (up to $3 \cdot 6 \times 10^6$ v.) less rapidly than would be expected on the Gamow theory of penetration of the particles through a potential barrier. Further, the activation of an element of atomic number as high as copper with deuterons of only 3×10^6 v. energy is much larger than would be expected on the Gamow theory. A theory is developed by J. R. Oppenheimer and M. Phillips (*Phys. Rev.*, *ibid.*) along the following lines: The deuteron is built of a proton and a neutron linked with a certain binding energy. When the deuteron is projected against a nucleus, the proton is held back by the repulsive field, but a wave-mechanical calculation shows that the neutron has a relatively high probability of entering the nucleus. The actual shape of the function giving the variation of the neutron penetration with energy depends on the binding energy; and a good fit with experiment is obtained by taking this about $2 \cdot 0 \times 10^6$ v., which is consistent with the value obtained by other methods.

Industrial Applications of Electrolysis

THE field of electrochemistry as it is concerned in the industrial deposition of metals, the electrolysis of alkali and alkali chloride solutions and oxidations, has been summarised by H. J. T. Ellingham in an article (*Chemistry and Industry*, 54, 895; 1935) which gives some useful general information. In recent years the electrolysis of fused sodium chloride for the production of sodium is tending to displace the earlier method of electrolysis of the hydroxide. The normal annual production of aluminium is 270,000 tons, while 20,000 tons of sodium and 2,500 tons of magnesium are produced per annum, with small quantities of calcium, cerium, beryllium, potassium and lithium. The principal countries producing aluminium are the United States, Germany, Canada, Norway, France, Italy and Great Britain, and during the last year the U.S.S.R. has become a major producer. For some years, the British Empire has produced about 20 per cent of the total output. The modern electrolytic zinc extraction process now competes with the retort process, and is operated on an increasing scale. The roasted zinc sulphide concentrates are extracted with dilute sulphuric acid and the rigorously purified solution is electrolysed between aluminium cathodes and insoluble lead anodes. Pure (exceeding 99·9 per cent) zinc is obtained, with cadmium as a by-product. Modern electrolytic plating and refining processes are also described.

Costing of Petroleum Refinery Operations

PROFIT and loss accounts are comparatively straightforward when cost and individual products can be assessed. With refineries, however, such assessment is not as a general rule practicable, since the main plants produce not one, but several, products. Allocation of operating costs to individual products is, therefore, an arbitrary matter. Mr. Gordon Kerr, who read a paper on "The Costing of Petroleum Refinery Operations" on October 8, before the Institution of Petroleum Technologists, suggests that, cost per product being inaccessible to refinery operators, process costs should be calculated. These being obtained, comparisons between the cost of operating plants from period to period, or for one refinery as opposed to another, are made possible. Moreover, in special circumstances, data are provided for comparison of alternative plants and methods of operation. In order to draw up a satisfactory process cost sheet, the processes to be costed must first be decided upon. Secondly, expenditure must be analysed and allocated to these various processes. Finally, distinction must be made between direct costs which automatically cease in the event of a particular process being discontinued, and indirect costs. These preliminary calculations having been made with the assistance of engineers, chemists and accountants, Mr. Kerr suggests that a perfectly satisfactory statement can be drawn up, and indicates the form it should take.

Symbols and Nomenclature in Physical Science

PROF. A. V. HILL'S recent letter[1] directing attention to the confusion arising out of the inconsistent use of symbols is a timely reminder of the need for greater uniformity. A certain amount of work in this direction has already been done. In 1914, committees of the Physical Society of London, and of the International Electro-Technical Commission reported upon this subject[2] and made certain suggestions as regards some of the more important physical symbols. The Smithsonian Physical Tables contains a table of symbols for electrical and magnetic quantities as adopted by the American Institute of Electrical Engineers, and the International Critical Tables gives a list of symbols based upon the recommendation of the International Association of Chemical Societies[3]. More recently, the S.U.N. Commission of the International Union of Pure and Applied Physics has recommended symbols for a limited number of physical quantities[4]. General agreement, however, upon anything like a sufficient number of symbols is not yet in sight.

Pending such agreement, as a step in the right direction and to prove its urgency, it would be instructive to have tables showing the variety of symbols employed by different authorities for the same physical quantity. A table giving symbols of some common thermodynamic quantities as found in a number of textbooks was compiled by the S.U.N. Commission in its report (mentioned above) and a similar table is appended here as an example; it will be seen how readily confusion can arise. Not only do the symbols differ, but also terms such as 'free energy' and 'thermodynamic potential' are used with different meanings by different authors.

With the exception of entropy, the various quantities given in the table are forms of (or have the

Quantity \ Author	Gibbs (1876)	Bryan (1903)	Goodenough (1912)	Planck (1922)	Planck (Eng. Trans. 1929)	Lewis and Randall (1923)	W. C. M. Lewis (1926)	S.U.N. Commission
Entropy	η	S	S	S	φ	S	S	S, P
Heat given to system	Q	Q	Q	Q	Q	Q	Q	—
Work given to system	−W	−W	W	A	W	−W	A	−W
'Free energy' (Helmholtz)	ψ	$\mathfrak{F}_v$	F	F	F	A	f	F
'Free energy' (Lewis and Randall)	ζ	$\mathfrak{F}_p$	φ	—	—	F	φ	G
Heat content	χ	$\mathfrak{F}_s$	I	W	H	H	—	H, I
Internal energy	ε	U	U	U	U	E	U	U, E

dimensions of) energy, and the relation between them, using Gibbs's notation, is:

$$\overbrace{\underbrace{Q}_{\chi} + \underbrace{\zeta}_{\psi} - W}^{\varepsilon}$$

where Q, W and ζ stand for the energies obtained by multiplying the extensive quantities, entropy, volume and mass by their respective intensive factors (or potentials), temperature $(d\varepsilon/dS)_{v,m}$, pressure $(d\varepsilon/dv)_{s,m}$ and thermodynamic potential $(d\varepsilon/dm)_{s,v}$. It is unfortunate that many authors have used the term 'thermodynamic potential' in referring to energy quantities. Bryan[5] has used it to denote ψ, χ and ζ; Ogg, in the English translation of Planck's "Thermodynamics", refers to the energy equivalent of ζ as "thermodynamic potential at constant pressure", and the term is used in the same sense even in the International Critical Tables.

In its recent report the S.U.N. Commission states (p. 20): "As to the four quantities, U, $U - TS$, $U - TS + PV$, $U + PV$, it was pointed out that they are all cognate and should be regarded as on a parity in the sense that they are all potentials, so that by suitable differentiations of each, any of them can yield the complete state of a substance, entropy or temperature, pressure or volume, thermoelectric current or e.m.f. . . . The British Committee are also prepared to accept the name Thermal Potential for Gibbs' function." It may be pointed out, however, that Gibbs (*Scientific Papers*, 1, 92) used the term potential in a different sense; he defined his thermodynamic potential as "the differential coefficient of the energy taken with respect to the variable expressing the quantity of the substance", as we have done above.

Two other points may be here touched upon:

Owing to the relatively large number of physical concepts, authors have often recourse to Greek, German and other alphabets in order to find distinctive letters. An alternative way would be to use a combination of two or more letters as is done for chemical symbols. This would also have the advantage of allowing one to distinguish between, say, gas pressure *Pg* and osmotic pressure *Ps*, while at the same time indicating other generic similarity.

The addition of one or more letters could be resorted to in order to direct attention to the operational meaning attached to a given symbol: for example, *Psh* might stand for "osmotic pressure measured hydrostatically across a semi-permeable membrane", while *Psf* might indicate "osmotic pressure calculated from freezing point determinations". The need for some such device to express the operational meaning of concepts in order to prevent many unnecessary controversies and paradoxes has been discussed at length in a previous paper[6].

To summarise—there are three points worth consideration:

(1) The need for comparative tables giving the different symbols used for the same concept by various scientific workers.

(2) The advantages of symbols consisting of several letters.

(3) The advisability of using symbols which express the operational meaning of a concept.

V. C.

[1] NATURE, 136, 222; 1935.
[2] NATURE, 94, 541, 545; 1915.
[3] *J. Chem. Soc.*, 119, 502; 1921.
[4] NATURE, 135, 419; 1935.
[5] "Encyc. Math. Wissensch.", Bd. 5, t. 1, p. 74; 1903.
[6] *Science Progress*, 26, 126; 1931.

Prof. Charles Flahault and the Scots College at Montpellier

PROPOSED MEMORIAL

MEN of science throughout the world will welcome the news that a movement is afoot to commemorate the work of the great geobotanist Charles Flahault. A committee of patronage has been founded to erect in L'Hort de Dieu, on Mont Aigoual, a commanding peak of 5,000 ft. in the Cevennes, a monument to the memory of this noted savant and essentially human figure. Flahault began life in modest circumstances. From being gardener of the Natural History Museum, Paris, he attained, through his undoubted ability, his application and hard work, the highest university degrees. At twenty-six years of age he found his place among the young savants of great promise. As professor in the Faculté des Sciences in 1883, he worked and taught for forty-four years in Montpellier, the University of which he never abandoned in spite of repeated calls of the Natural History Museum and of the Sorbonne.

Flahault was the founder in France of botanical geography, the aims, the methods and nomenclature of which he clearly defined. He organised the Botanical Institute of Montpellier, and by his learned words and guiding influence made Montpellier a noted centre for Mediterranean studies. His scientific activity aimed through all his life's work at an essentially human goal. He sought to discover and to teach the relationship of plant life to its environment and thereby to increase the yield of Nature for the benefit of man.

In retirement, Flahault turned his attention to the replanting of the *garrigues* and mountains, to the improvement of the cultural aspect of sand-dunes and to the uncultivated marshes which border the lagoons. The last seven years of his life were spent in this work, unceasingly giving practical advice, writing reports, articles and booklets into which he condensed the results of his researches and experiments. These included observations which he had made on the Aigoual in the Hort de Dieu, where he founded a botanical mountain garden and laboratory. Thus from the lagoons of the seashore to his hill-station on the edge of the Massif Central, Flahault revealed the unity of Mediterranean vegetation.

To students and men of science from Great Britain, the special significance of Montpellier and its region is its key-position at that point of the Mediterranean lands which is nearest to our own. This fact formed a fertile contact between Flahault and ecologists from our own shores. The unbroken friendship of the late Sir Patrick Geddes and Flahault, dating from the 'eighties, led to the founding of the Scots College (Le Collège des Ecossais) at Montpellier, and Geddes taking up residence there in 1924; the garden of the College with its wide variety of *garrigue* flora was planned by the two friends as an ecological museum of Mediterranean vegetation. Latterly, a co-worker of Flahault, M. Braun-Blanquet, has placed his Station Internationale geo-Botanique Mediterranéenne et Alpine (S.I.G.M.A.) in the College garden. Recently, at the College itself, the warden, M. Paul Reclus, has aided the supervision of ecological studies by British students. Thus the work of Flahault is continued, not only by his successor M. Pavillard at the University, but also at the College where so much of his time was spent. Students are ever welcome to this centre of study and research, and it is hoped that the College with such a beginning and tradition will receive the support of those interested in the allied sciences.

Progress in Road Research

THE first report of the Road Research Board, covering the two years ended on March 31, 1935, since the Department of Scientific and Industrial Research assumed responsibility for the researches on roads carried out at the Road Research Laboratory, Harmondsworth (H.M. Stationery Office. 3*s*. net), appears appropriately enough when an important discussion on science and the control of road traffic at the British Association meetings at Norwich has directed attention to the importance of road surface and similar factors in the prevention of accidents. A major group of problems with which the work of the Board is concerned is directly related to the reduction of accident ratios, the other main group of problems being concerned with economy in road construction and maintenance.

The report of the Board itself outlines the general policy pursued in its work and is followed by the report of the Director of Road Research. The first section of the latter report outlines a preliminary programme of research covering both materials and processes for road-making and providing for routine tests and *ad hoc* investigations by the highway authorities and the Ministry of Transport, which under the present scheme remains responsible for full-scale tests outside the Laboratory and is the channel of communication with highway authorities. This programme is designed to supply a real knowledge of all the fundamental factors involved in the processes and materials used by the industry, and the work falls into four main divisions: road construction, road usage, development of special testing apparatus, physiological and psychological effects.

The major part of the report is concerned with materials and processes for road construction. Investigations are outlined dealing with questions of the settlement, drainage and other characteristics of the sub-soil which are of importance with the use of large impervious surfaces in modern roads. The properties of the various road materials and their

mixtures with binders are being investigated to assess scientifically their suitability for use in road construction and to enable satisfactory specifications to be compiled. One of the first steps has been the designing of satisfactory workability tests for mixes. Bituminous binders are also receiving attention and co-operative research has been arranged with the British Road Tar Research Association. The report also stresses the importance of improving methods for the control of concrete during laying, and for the determination of the factors which influence the design and laying of road slabs and foundations.

In regard to road usage, special interest is attached to the studies of forces applied to roads by various types of vehicles, with the object of correlating these forces with the type of pavement, subsoil and vibration, as well as to attempts to determine the factors in vehicle design and usage which cause damage to the road. The value of scientific knowledge on these points needs no emphasis, while the importance of the attention being given to the problem of skidding is equally apparent. This work aims at determining the factors in vehicle design which induce skidding as well as those factors in road construction and road conditions which promote skidding. An apparatus for assessing the slipperiness of wet surfaces has been designed which has given numerical values for the slipperiness of surfaces in good accord with experience of actual usage of the roads tested. The work has shown, rather surprisingly, that in wet weather roads are in general more slippery in summer than in winter. Other work on road testing machines has been designed to provide some other means of judging durability than waiting for deterioration under normal usage, and it is hoped that the machines being built will form a link in the chain between the laboratory and the road, and ultimately establish a scale against which the probable performance of new forms of materials and construction can be estimated.

The report shows that a good beginning has been made on a programme of research not incommensurate with the expenditure of more than £50,000,000 involved in the making and upkeep of roads in Great Britain and in the problem of road safety.

Technical Features of the *Normandie*

AT a joint meeting of the Institution of Mechanical Engineers with the Société des Ingénieurs Civils de France (British Section) held at the Institution of Electrical Engineers on November 15, M. Jean Marie read a paper on the *Normandie*. He gave a very interesting description of the precautions taken against fire. The first precaution is the use so far as possible of fireproof materials for floor, ceiling and wall coverings. Where the use of materials such as plywood, linoleums, rubber carpets, etc., was unavoidable, these were made almost incombustible by the use of asbestos and fire-resisting paints. The only really combustible materials are the bedding, linen, clothes and the passengers' and crew's luggage. The outbreak of fire is limited by partitioning, six cabins being the maximum in the subdivisions. If a fire, however violent, breaks out in one of them, its extent is limited for more than thirty minutes by the insulating barrier, the temperature remaining normal during this period in the neighbourhood of the attacked cell.

There is a special fire patrol which has its headquarters in the central security post, with which 1,075 automatic devices are connected to give the alarm. If it happens to be a cabin, a red alarm light appears in the corridor. No bell system is installed in order to avoid the risk of a false alarm among the passengers should a bell ring accidentally. In the engine rooms, an outbreak is safeguarded against by means of a hose supplied with carbonic acid foam. In the lower parts of the ship, a plentiful introduction of carbonic gas can be arranged and in the upper parts there are numbers of fire extinguishers. Flying scaffolds are provided so that it is possible to introduce a hose, fed from an upper deck through a porthole, or shut the porthole should it allow a draught. The officers, staff and men who maintain this safety service are specially recruited for the purpose.

The electric lighting system is of low voltage (110 volts) and the power and lighting wires are everywhere kept separate. It is possible to cut off the electric supply from the single zone where a fire might originate. The fight against the outbreak and the normal life on board are thus not interfered with. In the main public rooms, marbles, onyx, plaster of Paris and glass (moulded or worked) have been used as much as possible. Furniture is either of metal or of a fire-resisting wood. Safety paints and varnishes are employed; all of them were tested to see that their burning point was not less than 400° C., and that their liability to spread fire was less than a certain fixed standard.

As the length of the *Normandie* is 1,029 ft. and the breadth at the overhang of the promenade deck is 120 ft., it is out of the question to use oil engines on account of the power that has to be developed, the weight and size of the engines and the risk of vibration resulting from the use of reciprocating moving parts. Water tube boilers and steam turbines were therefore chosen. Electrical transmission of the power generated to the propellers was chosen because of the absence of noise. It has, however, the disadvantage that it cannot be reversed, and so separate machinery has to be used for going astern. A double hull protects the two rooms where all the machinery is located.

The main power station has four 33,400 kilowatt turbo-alternators which run at 2,430 r.p.m., which is ten times faster than the propeller motors. On its first trip, the *Normandie* captured the coveted 'blue riband' of the Atlantic, going westward at an average speed of 29·98 knots and returning at 30·31 knots.

In all fast ships, vibration appears and is troublesome at definite speeds, and the *Normandie* is no exception. Alterations are being carried out during this winter to remedy this inconvenience, and the Compagnie Générale Transatlantique believes that they will be successful.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notice that the Jacksonian professorship of natural philosophy is vacant. The professorship is assigned for this turn to experimental physics, and intending applicants should inquire of the Vice-Chancellor whether provision can be made for the researches that they wish to conduct. Applications must be sent to the Vice-Chancellor on or before December 31.

Sir Rowland Biffen has been appointed to act as head of the Department of Agriculture during the absence on leave of Prof. F. L. Engledow, Drapers' professor of agriculture, from November 15 until April 2, 1936.

Mr. G. E. Briggs has been appointed to act as director of the Sub-Department of Plant Physiology during the absence on leave of Dr. F. F. Blackman, reader in botany, in the present term and Lent term, 1936.

The absence of Prof. F. J. M. Stratton with the eclipse expedition during the Lent and Easter terms 1936 has necessitated the appointment of Dr. T. W. Wormell as acting head of the Department of Astrophysics and director of the Solar Physics Observatory during that period.

AT the time of going to press, the following representatives of university parliamentary constituencies in Great Britain and Northern Ireland were announced as elected or returned unopposed: Cambridge, Sir John Withers (Unionist) and Mr. K. Pickthorn (Unionist); Combined English Universities, Miss E. Rathbone (Independent) and Sir R. Craddock (Unionist); London, Sir Ernest Graham-Little (National); Oxford, Lord Hugh Cecil (Unionist), Mr. A. P. Herbert (Independent); Queen's University, Belfast, Colonel T. Sinclair (Unionist); Wales, Mr. E. Evans (Liberal).

THE School of Librarianship at University College, London, has published an account of its present courses. In the new syllabus for the diploma, stress is laid on languages, especially French and German, the latter being compulsory, and on practical work in cataloguing, classification and library administration. Candidates may specialise in palæography and archive work or in university or special library administration. Fees for the postgraduate diploma course amount to about £45 for tuition, registration and examination fees and books. The school was opened sixteen years ago, and received substantial assistance for a period of ten years from the Carnegie United Kingdom Trust. Its sphere of usefulness has expanded since then with the remarkable development of library services in the south of England, especially London and the home counties, where the number of registered municipal library users increased in five years by 56 per cent, and county library users and book stocks more than doubled. There is no indication in the prospectus of measures for giving effect to the resolutions passed at the recent International Congress at Madrid in favour of special courses for rural librarians and hospital librarians, but it is stated that a course may be arranged in the Easter or summer vacation.

Science News a Century Ago

Meeting of the Royal Society

AT a meeting of the Royal Society on November 26, 1835, Sir John Rennie being in the chair, two papers were read. The first of these was by E. J. Cooper and was communicated by Captain Beaufort. It was entitled "Observations on Halley's Comet made at Mackree, Sligo, in the months of August, September, October and November 1835". The observations, which were made with an equatorial telescope having a focal length of 25 ft. 3 in., "were communicated in the state in which they were taken, and without corrections for refraction and parallax, with a view to assist computors in the calculation of a new approximate orbit".

The second paper, "An Account of the great Earthquake experienced in Chili, on 20th February 1835", was by A. Caldcleugh. "The earthquake," the author said, "began at half-past eleven o'clock in the morning. The first oscillations of the earth were gentle and attended with little noise. They were succeeded by two extremely violent tremors, continuing for two minutes and a half. All the buildings of the town of Conception were thrown down during these undulations". Later on "an immense wave was seen slowly advancing towards the shore, and rolling majestically onwards, in ten minutes reached the city of Conception, which was soon overwhelmed in a flood of an altitude of 28 feet above high water mark. . . . Vessels navigating the Pacific Ocean within a hundred miles of the coast, experienced the shock with considerable force. Its influence was very perceptible in the island of Juan Fernandez, a basaltic mass 360 miles distant from the coast; as was shown by the sudden elevation and subsidence of the sea, which at one time rose 15 feet above the usual level carrying all before it."

British Railways and Steamships in 1835

THOUGH a century ago the mileage of railways completed in Great Britain was quite small, a large number of lines were either in hand or being planned, and the advertisement columns of *The Times* of November 1835 contained many notices of meetings, prospectuses, etc., of railway companies. From London alone there were plans for lines to Birmingham, Greenwich, Bristol, Cambridge and the north, the eastern counties, Dover and Folkestone, Shoreham and Brighton, Southampton and other places. Robert Stephenson was the engineer of the London and Birmingham Railway, Brunel of the Great Western Railway, Joseph Gibbs of the Great Northern Railway, Charles Vignoles and John Braithwaite of the Eastern Counties Railway, Rastrick of the Brighton line, while George Stephenson was the engineer of the London and Blackwall Railway and Sir John Rennie of the Commercial Railway to the East and West India Docks. There were projects also for lines from Birmingham to Bristol, from Bristol to Exeter, from Exeter to Plymouth and Devonport, while among the lines in the north was one from Newcastle-upon-Tyne to North Shields and Tynemouth.

In *The Times* of November 28, 1835, was also a notice of the formation of the British and American Steam Navigation Company with a capital of £500,000, which ultimately built the two pioneer trans-Atlantic vessels *British Queen* and *President*.

Societies and Academies

LONDON

Royal Society, November 14. G. L. BROWN and SIR HENRY DALE: The pharmacology of ergometrine. Ergometrine produces the central excitation, with general sympathetic stimulation, previously described as an initial phase of the action of the more complex alkaloids of the ergotoxine group. It has, however, no more than a trace of the specific paralysing action on motor sympathetic effects, characteristic of these other alkaloids. It causes cyanosis of the cock's comb, but the effect is evanescent and has not led to gangrene. It causes a rise of body temperature when given in toxic doses. It is in general less toxic than ergotoxine, and is much more readily absorbed with oral administration. The most characteristic action of ergometrine, and the only one produced by small doses, is the initiation of a long persistent rhythm of powerful contractions in a uterus normally quiescent, as in the early puerperium. On several organs, apart from the centrally excited sympathetic stimulation, ergometrine appears to have a peripheral action of sympathomimetic type. This, however, is much complicated by other types of action, and does not account for its specific action on the uterus. M. J. D. WHITE: The effects of X-rays on mitosis in the spermatogonial divisions of *Locusta migratoria*, L. X-rays produce both lethal and non-lethal effects in the spermatogonia of *Locusta migratoria*. Cells which are killed go into pycnosis. Those which are not killed show different kinds of chromosome abnormalities. The commonest of these is chromosome fragmentation. Fragmentation of the *X*-chromosome is much rarer than autosomal breakage. A new type of chromosome abnormality which leads to chromatid-tetraploidy with only a diploid number of spindle attachments is described. It is believed that this results from inhibition of the division of the spindle attachment following on irradiation. The whole of the work strongly supports the view that the spindle attachment is a constant cell-organ and that new spindle attachments only arise from pre-existing ones. The independence of the spindle attachment from the rest of the chromosome in regard to time of division is emphasised by the new abnormality of mitosis described above. Evidence is presented that the spindle attachments in the Acridiidae are not terminal, as hitherto believed, but sub-terminal. D. E. SLADDEN: Transference of induced food-habit from parent to offspring (2). Experiments with the stick-insect (*Carausius morosus*) in which the insects for several generations were forced to accept a new food-plant (in this instance ivy) and then reared to maturity on it, have shown that the offspring of each subsequent generation accepted the ivy more readily than did their parents and even showed an increased preference for it. The increasing ability of offspring of ivy-fed parents to eat ivy indicated in experiments previously recorded is still maintained, though the rate of increase is slowing down as is clearly shown by the presentation tests. The preference tests continue to show an increased preference for ivy.

PARIS

Academy of Sciences, October 21 (*C.R.*, 201, 693–748). HYACINTHE VINCENT: Remarks on streptococcæmia with accounts of some new results of serotherapy in this infection. Out of 310 cases of septicæmia due to streptococcus, 81 per cent were cured by the author's serum treatment. Stress is laid on the necessity of applying the serum treatment as early as possible. JEAN CABANNES and JEAN DUFAY: The spectrophotometric comparison of the zodiacal light and the light from the night sky. It results from these observations that the zodiacal light emits neither the line 5577 nor the bands 4838 and 4425. Allowing for the radiations from the night sky, the zodiacal light gives essentially a continuous spectrum with Fraunhofer lines. GEORGES BOULIGAND: The conditions of covariance of Meusnier's sphere. RAPHAËL SALEM: Certain continued functions and the properties of their Fourier's series. KARL MENGER: A general theorem of the calculus of variations. N. A. SLIOSKINE: Permanent capillary waves. HENRI MINEUR: The age of the Milky Way. LOUIS LEPRINCE-RINGUET: The sudden energy losses undergone by high energy electrons. LÉVI HERMAN and MME. RENÉE HERMAN: The absorption of oxygen in the ultra-violet. NY TSI-ZE and WENG WEN-PO: The influence of the electric field on the absorption spectrum of sodium. GEORGES BRUHAT and LOUIS WEIL: The construction and use of a quarter-wave plate made of quartz. MLLE. YVETTE CAUCHOIS: New measurements and observations relating to the non-diagram $L\alpha$ emissions of mercury, platinum and tungsten. PIERRE PREISWERK and HANS VON HALBAN, JR.: Some radio-elements produced by neutrons. Results obtained by irradiation with neutrons (radon + beryllium) of thallium, bismuth and phosphorus. The results of Sosnowski with bismuth were not confirmed; no activity was detected. J. CHÉDIN: The Raman effect in fuming sulphuric acid. Acids containing a high percentage of SO_3 give no line in common with H_2SO_4 and hence in fuming sulphuric acids containing up to 70 per cent of SO_3 the H_2SO_4 is entirely combined with SO_3. OCTAVE DONY-HÉNAULT and CLAUDE DECROLY: The direct determination of the concentrations of the zinc vapour in the thermal reduction of zinc oxide. MARCEL PRETTRE: The mechanism of the chain reaction of the hydrogen–oxygen mixture. The velocity of the reaction in glass coated with potassium chloride obeys the law of Arrhenius, it is sensibly proportional to $(H_2)^2$, to (O_2) and to p^4 (apparent order of reaction, about 4). The results are in agreement with the scheme suggested by Haber. GEORGES DARZENS and ANDRÉ LÉVY: The synthesis of octohydromethylphenanthrene carboxylic acid and of 4.methylphenanthrene. JOSEPH HOCH: A general method of synthesis and the chemical properties of the isocyanic α-ethylenic esters of the formula $R.CH=CR'.N=C=O$. The *N*-carboxethylketimines, for which the author has given a general method of preparation, are heated to 400° C. with a catalyst. MARC BASSIÈRE: The crystalline structure of silver nitride. The group N_3 is linear, the distance between the atoms being $1{\cdot}18 \pm 0{\cdot}04$ A., of the same order as those previously observed for other nitrides. GEORGES PETIT and PAUL BUDKER: The differentiation of cutaneous teeth, connected with the presence of sensorial crypts, in some Selacians. PAUL WINTREBERT: The explanatory value of physiological epigenesis. CHARLES JOYEUX and JEAN GEORGES BAER: Researches on the evolutive cycle of *Hymenolepis pistillum*. CONSTANTIN LEVADITI and MLLE. JEANNE VOET: A new classification of the neurotrope ectodermoses. FERNAND ARLOING, ALBERT MOREL and ANDRÉ JOSSERAND: The action on tumours, with intravenous injections, of new soluble complex ferrico-ascorbic salts.

EDINBURGH

Royal Society, November 4. A. D. PEACOCK: Some aspects of animal parthenogenesis. An address mainly surveying recent researches, namely, haploid parthenogenesis and the viability of haploids in the light of cytological work; Whiting's hypotheses of 'complementary factors' and 'selective fertilisation', educed from genetical experiments, whereby the diploid female hymenopteron appears to be heterozygous for sex, XY, while the haploid males, though phenotypically alike, are of two types, X and Y; Guhl and Dozorceva's cytological evidence for Whiting's thesis; Vandel's work on geographical parthenogenesis and his evidence that the rare triploid males of a triploid parthenogenetic race of *Trichoniscus* show 'change of valency of the sex genes'; sex control experiments in cyclic forms by Banta, Shull, Tauson, Luntz and others, with Berg's hypothesis that males appear as the result of 'physiological depression'.

BRUSSELS

Royal Academy of Sciences (*Bull. Classe Sci.*, 21, No. 8–9, Aug. 1935). A. DEMOULIN: Sphere congruences of which the curvature is equal to one. P. FOURMARIER: A new observation à propos schistous cleavage. G. BOULIGAND: Stability of mathematical propositions (2). J. L. DESTOUCHES: Abstract spaces in logic and the stability of propositions. P. BURNIAT: Birational quadratic transformations in hyperspace. M. DE HEMPTINNE and J. M. DELFOSSE: Contribution to the study of the Raman spectrum of heavy and light phosphoretted hydrogen. An experimental study of the Raman spectra of these substances and a comparison with the theory of the vibrations of a tetrahedral molecule. L. VERLAINE: The analytical character of perception in the macaque (2). A further attempt to educate the macaque to recognise various simple geometrical shapes and colours.

CRACOW

Polish Academy of Science and Letters, October 7. S. ROZENTAL: The analytical form of the approximate functions of state of the light atoms. W. SWIETOSLAWSKI, M. WOJCIECHOWSKI and E. SAPIRO: Researches by the boiling point method on the amount of impurities in succinic acid, proposed as a secondary thermochemical standard. The sample of succinic acid used by L. Keffler in his thermochemical work was found to contain 0·002 per cent of water. The method was also applied to determine the amount of water produced by the decomposition of the acid on prolonged heating to various temperatures. M. CENTNERSZWER and M. BLUMENTHAL: The formation and dissociation of the peroxides of the metals of the alkaline earths. M. CENTNERSZWER and MLLE. M. SWIERCZEWSKA: The lowering of the boiling point of a ternary system by non-volatile substances. The influence of potassium chloride on the boiling point of aqueous solutions of calcium chloride. At a certain concentration of calcium chloride, the boiling point remains unchanged on the addition of the third component. The author terms this an 'indifferent' solution. K. DZIEWONSKI and J. KOWALCZYK: Study of α-methylnaphthalene. WL. SZAFER: The method of 'isopolles' applied to researches on the history of trees and forests. The 'isopolle' is a line corresponding to equal amounts of pollen of the trees at different periods of time. As an example, the method is applied to the post-glacial history of the beech and spruce in Poland. J. MADALSKI: The Pleistocene flora of Sciejowice, in the neighbourhood of Cracow. R. WILCZEK: Mosses with forest associations in the mountainous region of the Cieszyn district. J. BIBORSKI: The segmentary vessels and vessels of the unpaired fins of the plaice (*Pleuronectes platessa*). A. ZIELINSKI: Phosphorus and the embryonic development of the frog.

GENEVA

Society of Physics and Natural History, October 17. P. ROSSIER: The calculation of the initial radius of a new star. The author gives a new formula which takes into account the fact that the sensibility of the eye is extended over a wide range of wave-lengths. The calculation is very simple if use is made of a table of absolute colour index. F. CHODAT and A. MIRIMANOFF: Conservation and respiratory rate of yeasts in the presence of glucose. The authors show by means of manometric measurements that the presence of sugar is necessary for the maintenance of the respiratory coefficient of yeasts kept at a temperature of 60° C. G. TIERCY: Conservation of the polytropic character of thermodynamic equilibrium in the hypothesis of the θ variable or β variable. It is a question of finding under what conditions the total pressure keeps the characteristic form of polytropic equilibria. The general form of the algebraic condition is given.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 2; 1935). N. MUSHELISHVILI: Solution of a mixed fundamental problem of elasticity in two dimensions. V. LUSTERNIK: The Brunn-Minkowski inequality in the case of any measurable quantities. W. TURKIN: A generalisation of a theorem of group theory by Landau. D. PANOV: A method of solution of limited problems in the case of differential equations with partial derivatives. B. NUMEROV: General formulæ for the development of perturbing forces in the calculation of absolute perturbations in polar co-ordinates. M. PODASHEVSKIJ: Influence of the photochemical coloration on the limits of stretching and of rigidity of rock-salt monocrystals. M. BRONSTEIN: Scattering of neutrons by protons. S. LEBEDEV and S. SERGJENKO: The dimerisation of butadiene-1, 3. B. RUBIN and L. NAUMOVA: Contribution to the methodology of the determination of ferments. B. DOSTOVALOV: Measurement of the dielectric constant and the specific resistance of rocks. L. BERG: Ecological parallels between lampreys and Salmonidæ. V. VOLOSCHUK: A new mite occurring in stored grain.

SYDNEY

Royal Society of New South Wales, October 2. A. R. PENFOLD and F. R. MORRISON: The essential oils of *Eucalyptus Australiana* and its physiological forms (1). *Eucalyptus Robertsoni* and *E. Phellandra* are simply physiological forms of *Eucalyptus Australiana* and they have now been described as varieties *A* and *B* respectively. These varieties, the essential oils of which are described, cannot be separated from the type, *Eucalyptus Australiana*, by morphological means, and are indistinguishable in the field. The chemical and physical constants of the various essential oils are given. G. F. K. NAYLOR: Palæozoic sediments near Bungonia: their field relations and graptolite fauna. The author discusses the evidence for assigning various geological ages to Palæozoic

sediments occurring east of Goulburn. He concludes that the following periods are represented: Upper Devonian, Upper Silurian (Ludlow stage), Lower Silurian (Llandovery stage), Upper Ordovician (Caradoc stage and Llandeilo stage). The Ordovician and Silurian series are overfolded in such a way that all the dips are westerly. The graptolites which have been collected from this area include several species of *Diplograptus* (*Orthograptus*) and *Monograptus*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 24

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. H. Smith: "Animal Communities".*

Monday, November 25

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—W. Campbell Smith: "Bible Minerals".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—A. M. Champion: "The Life of a Kenya Frontier Officer".

ROYAL AERONAUTICAL SOCIETY, at 6.—(at the Institution of Electrical Engineers, Savoy Place, W.C.2).—Dr. S. J. Zand: "Sound Proofing of Aircraft".

ROYAL SOCIETY OF MEDICINE (TROPICAL DISEASES AND PARASITOLOGY SECTION), at 8.30.—Dr. Magarino Torres: "Further Studies on the Pathology of Alastrim and their Significance in the Variola-Alastrim Problem" (Lloyd Roberts Lecture).

Tuesday, November 26

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION), at 4.30.—H. C. Sampson: "The Tana River Region of Kenya Colony".

ROYAL INSTITUTION, at 5.15.—Prof. Edward Mellanby: "A Survey of Modern Views on Nutrition" (succeeding lectures on December 3, 10 and 17).

Wednesday, November 27

ROYAL SOCIETY OF ARTS, at 8.—F. A. Secrett: "Modern Methods of Vegetable Production and Marketing".

Friday, November 29

QUEEN MARY COLLEGE (CHEMICAL COLLOQUIUM), at 5.—Prof. H. Freundlich: "Some Recent Developments in Colloid Science".*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. A. V. Hill: "Muscles and Nerves: Posture, Power and Communications in the Body" (Thomas Hawksley Lecture).

ROYAL INSTITUTION, at 9.—Sir James Jeans: "The Size and Age of the Universe".

Saturday, November 30

ROYAL SOCIETY, at 2.30.—Anniversary Meeting.
Sir Frederick Gowland Hopkins: Presidential Address.

Official Publications Received

Great Britain and Ireland

Public Museum, Gloucester. Occasional Papers, No. 3. Romano-British Pottery from the Site of the Girls' High School, Denmark Road, Gloucester, and a Romano-British Grave Group from Gloucester. By Charles Green. Pp. 8. (Gloucester: Public Museum.) 2*d*. [411

Aeronautical Research Committee. Report for the Year 1934–35. Pp. iv+74+4 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [511

Chemistry and the Body Politic. By Sir William H. Bragg. (The Seventh S. M. Gluckstein Memorial Lecture, 1935.) Pp. 18. (London: Institute of Chemistry.) [511

County Council of the West Riding of Yorkshire: Education Committee. Thirty-first Annual Report of the Education Committee for the Year ended 31st March 1935. Pp. 56. Report on the Examination for County Minor Scholarships, 1935. Pp. 38. Handbook of the Education Committee, Part 2: Higher Education. Section 10: Regulations relating to Scholarships and Exhibitions and the Training of Teachers, 1936. Pp. iii+44. (Wakefield: Education Office.) [511

Philosophical Transactions of the Royal Society of London. Series A, No. 747: III—The Structure and Physical Properties of Thin Films of Metal on Solid Surfaces. By Prof. E. N. da C. Andrade and Dr. J. G. Martindale. Pp. 69–100+plates 13–20. (London: Harrison and Sons, Ltd.) [511

Tropical Diseases Bulletin. Vol. 32, Supplement: Medical and Sanitary Reports from British Colonies, Protectorates and Dependencies for the Year 1933. Summarized by Dr. H. Harold Scott. (Fifth Annual Issue.) Pp. 280. (London: Bureau of Hygiene and Tropical Diseases.) 7*s*. 6*d*. net. [611

The Calculus of Plenty (The Norman Lockyer Lecture, 1935.) By Sir Josiah Stamp. Pp. 35. (London. British Science Guild.) 1*s*. [1311

Other Countries

Newfoundland: Department of Natural Resources: Division of Fishery Research. Vol. 2, No. 3: Annual Report of Fishery Research Laboratory, 1934. Pp. 79+2 plates. 1 dollar. Vol. 2, No. 4: The Dried Codfish Industry. By Dr. N. L. Macpherson. Pp. 57. 50 cents. St. John's: Department of Natural Resources.) [211

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 15, No. 10: Über Flächen und Kurven (14); Beiträge zur Geometrie der Kreise und Kugeln (14). Von Soji Matsumura. Pp. 245–264. (Tôkyô: Maruzen Co., Ltd.; Taihoku: Taiwan Nichi-Nichi Shinpô-Sha.) [411

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1934. Pp. ii+107. (Bangalore: Indian Institute of Science.) [411

Proceedings of the Fourth Silvicultural Conference, Dehra Dun, October 28th–November 4th, 1934. Pp. 11+818. (Simla: Government of India Press.) [411

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 3: Parent Education Opportunities. By Ellen C. Lombard. Pp. viii+54. 10 cents. Bulletin, 1935, No. 4: Compulsory School Attendance Laws and their Administration. By Walter S. Deffenbaugh and Ward W. Keesecker. Pp. vii+96. 10 cents. Pamphlet No. 63: The Education of Native and Minority Groups; a Bibliography, 1932–34. By Katherine M. Cook and Florence E. Reynolds. Pp. 25. 5 cents. (Washington, D.C.: Government Printing Office.) [511

Union of South Africa: Department of Mines: Geological Survey. The Geology of portion of the Country East of Steytlerville, Cape Province: an Explanation of Sheet No. 150 (Sundays River). By S. H. Haughton; with a Chapter on Underground Water Resources, by H. F. Frommurze. Pp. 44. (Pretoria: Government Printing Office.) 5*s*., including Map. [511

The Museum Journal. Vol. 24, Nos. 2–3: Evidence of Early Man in North America. By Edgar B. Howard. Pp. 53–176. (Philadelphia: University of Pennsylvania.) 1.50 dollars. [511

Smithsonian Miscellaneous Collections. Vol. 94, No. 8: The Manahoac Tribes in Virginia, 1608. By David I. Bushnell, Jr. (Publication 3337.) Pp. iv+56+21 plates. Vol. 94, No. 11: Melanesians and Australians and the Peopling of America. By Aleš Hrdlička. (Publication 3341.) Pp. ii+58. (Washington, D.C.: Smithsonian Institution.) [511

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Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3448 SATURDAY, NOVEMBER 30, 1935 Vol. 136

Education and Leisure in Progressive Life

THE extent of unemployment in the world to-day in itself has forced attention on the problem of leisure. Plans have already been proposed for the wider distribution of leisure as a contribution towards the reduction of unemployment by raising the age of entry to industry at one end and lowering the age of exit at the other. Similarly, the reduction of working hours has been advocated as a means of distributing leisure and employment more equably.

Behind such proposals lies the fundamental belief that the increased powers of production which the advance of mechanical and physical science has placed within man's power, if rightly used, make possible a higher standard of living for all and also the attainment of that standard through less physical effort and with consequent greater leisure than ever before. Already this belief is challenging economic and political systems or dogma which prevent the realisation either of that higher standard of living or that fairer distribution. There is a widespread readiness to try new methods if the old prove inadequate.

The very linking of the problem of leisure with that of unemployment in such ways as these has, however, proved an obstacle to clear thinking on the fundamental issues with which the coming of leisure confronts us. Only slowly are we coming to see that education must be a preparation for leisure as much as for work.

Work and leisure cannot well be separated; one is complementary to the other. Life must be viewed as a whole, and, whether from the educational point of view or the wider social point of view, a society which does not provide the training or the facilities for the adequate enjoyment of leisure is in as dangerous a condition as a society in which training and opportunities for earning a livelihood are defective. The view of education as a preparation not merely for work but also for life, the conception that the provision of adequate facilities for recreation and the right use of leisure is a prime function of the State, are so revolutionary as to involve a radical change in our views on education and other questions.

The situation calls for much creative and fundamental thought, and it was with this conviction that in 1934 the New Education Fellowship commenced a comprehensive inquiry into the subject. The outcome of the first part of this inquiry is embodied in a report which has recently been issued under the title "The Coming of Leisure"*. This report outlines the problem as it exists in England to-day, and shows the directions in which solutions are being sought. It formed one basis of the discussions at a conference held at the University of St. Andrews on August 13–22.

The report naturally starts with the problem which leisure presents to education in its narrower sense. If education, whether at school or in adolescence or in adult life, is to be a preparation not merely for work but also for life, the fundamental policies in our system of national education require drastic modification. The belief that we have merely to teach a child a certain number of subjects with some relevance to the way in which he is to earn his living, and which will provide him with a modicum of knowledge and give him the facility for acquiring more, is hopelessly inadequate if we are to educate for leisure.

If therefore education is to help youth to master the means of making life worth while a new method of approach may be required if not an entirely new technique, and a complete change in

* The Coming of Leisure. the Problem in England. Edited by E. B. Castle, A. K. C. Ottaway and W. T. R. Rawson Pp. 78. (London: New Education Fellowship, 1935.) 2*s.* 6*d.*

the attitude of both teachers and administrators. Notably is this true in the reorganised elementary school if the purpose of the Hadow report is to be realised, and unhappily all too rarely is there betrayed in discussions on the raising of the school leaving age any realisation of the possibilities of wider experiment and adventure in education which are bound up in the reorganisation outlined in that report.

The difficult problems which leisure and education present in adolescence are largely the result of defective education at an earlier stage. Even in adolescence, the question of idle hours due to unemployment can assume serious dimensions. Such idle hours must not be termed leisure. Neither education for leisure nor any other kind of education is possible for human beings living a precarious and hand-to-mouth existence. The essential basis for the education of the adult, whether regularly employed or not, is freedom from the grosser evils of poverty, helplessness and the sense of not being wanted. It is only in an atmosphere of freedom from these evils that the expression of personality is possible and the creative instinct finds full play.

This, in fact, is the centre of the problem—the securing of full play for human personality and the creative instinct within the ranks of an organised society. It involves, of course, much more than education. It involves the evolution of sociology into an organised science, as distinct from a mere body of organised knowledge, as well as the working out of ways and means by which the enormous increase in the productive powers placed in man's hands may be utilised to secure a wider and more equable distribution of leisure for all, together with the higher standard of living which is possible with the wise use of such powers.

These are tasks demanding no small measure of scientific investigation and creative thought as well as wise statesmanship, and it is only when they have been accomplished that the educationist can enter on his full opportunity. In the meantime he has much preparatory work to do. Apart altogether from his influence in the training of the right type of leader, his influence may easily be decisive in the formation of a society and a public mind which is capable of supporting and following great leadership. The statesman, it must be remembered, too often has to content himself with what he believes it to be possible to get accepted, not with what he believes to be the most altruistic and noblest solution of a problem.

Even in this work of developing a society with a capacity to accept change and advance to a finer social order, the educationist has much to do. What may be termed the educational climate of the country has completely changed. The extensive growth of social amenities, the cheap production of books, magazines and newspapers, the influence of the cinema, the wireless and gramophone have diminished the demand for formal education. The educational process has become more and more one of unconscious absorption and less and less the deliberate satisfaction of a conscious need.

This change has several consequences. It enforces close consideration of possibilities which both the cinema and broadcasting offer for cultural purposes, and the development of a new and appropriate technique both for schools and for adult education. It demands also the development of a new technique of art education which shall contribute to the enrichment of leisure hours, and encourage the expression of creative instincts and personality whether in speech or drama, in reading or in writing. Again, the advance of science and the gradual replacement of physical labour by mechanical power have enhanced the need for physical education, so that physical recreation represents one of the major problems in the right use of leisure. Scarcely anywhere is there more need of wise and skilful guidance to secure the full value from existing opportunities and to guard against unbalanced or untoward effects whether in games, in handicraft or in gardening and like activities.

Much the same applies to the opportunities for what may be described as social adventures provided by young people's clubs and societies whether of the indoor type or for camping and rambling or the like. Wise guidance is again needed if gifts for leadership are to be encouraged and developed and not repressed, and the full value of such activities realised.

Yet another consequence is even more fundamental. Progress may well depend finally on whether we are able to liberate the world from what Prof. William McClelland has rightly termed the degrading exploitation of mass suggestion. All the evidence suggests that we are in the midst of a new renaissance through which humanity is struggling to rise to a higher level of culture. We have to prepare youth for a world where everything is in a state of flux, and the fundamental need is to train up a strong flexible creative generation with

the spirit of adventure of the pioneer on the intellectual side. To do this, education must be continuously directed towards preparing youth to think for itself. Freedom of thought is an essential preliminary alike to the creative thought which is our supreme need or to that intelligent thought on vital issues in social and international relationship in which statesmanship can function.

More and more it becomes apparent that what is needed is not merely the capacity to deal with and evaluate facts, but also the capacity to deal with contingent truth. Far too little training is given in arriving at opinions, weighing evidence, sifting motives, discounting prejudices and resisting suggestions. The very advance of science itself depends upon the development of such capacity. Prof. Julian Huxley has recently indicated how sociology can only develop into a true science as it formulates its methods for dealing with multiple effect and multiple causation.

The coming of leisure thus sets before us not indeed the problem of education for leisure but of re-examining and re-orientating our whole system of education for life. Very largely indeed the survival of civilisation depends upon our capacity to plan and put into force an educational policy, wisely co-ordinated over the whole field, so as to produce citizens capable not merely of efficient workmanship but also physically and mentally equipped to enjoy the full resources of life at our disposal. These are the conditions in which independent and creative thought is possible and in which leadership will flourish. Our task, as Whitehead reminds us, is not the production of great leaders. A great society will always put up the great men for the occasion. It is the task of establishing a great society in which adventurous and creative thought and living flourish, and to that task the whole range of problems involved in the increase of leisure summon us anew.

Agricultural Production and National Nutrition

The Agricultural Dilemma:
a Report of an Enquiry organised by Viscount Astor and Mr. B. Seebohm Rowntree. Pp. xiii + 101. (London: P. S. King and Son, Ltd., 1935.) 2*s*. 6*d*. net.

IN the volume before us Lord Astor and Mr. B. Seebohm Rowntree present the results of an inquiry organised by them into the possibilities of increasing the agricultural population of Great Britain. The 'dilemma' which the authors postulate is the difficulty of reconciling increasing employment in the production of foodstuffs at home with increasing technical efficiency, falling population, the nationalistic policies of other countries, and Great Britain's relationship—in peace and in war—with the Empire overseas, and with friendly neutral countries. The conclusion is reached that the present conditions of over-production and unremunerative prices will prove in some degree a persistent rather than a transient phenomena: that imports of vegetables, poultry, fruit, etc., have already been reduced to the limit that is desirable: that any drastic reduction of our imports of such special foodstuffs as wheat, beef, mutton and bacon (which alone could allow of a specific increase in domestic production) would seriously aggravate the economic difficulties of the world, would entail a further loss of export trade and imperil the solidarity of the British Empire and our good relations with neutral food-producing countries.

If it were not for the element of truth in some of these arguments, our agricultural policy would be easy—no need for quotas, trade agreements or marketing boards. What a delightful life for the Minister of Agriculture. As it is, however, he has to build a structure within the main girders of a national policy, utilising as best he can those girders which are already in position, adjusting others, or persuading his colleagues that the main building will be the more secure if a few of his brand new ones take the place of theirs.

What this book in fact tells us is that we had better give up hopes of any material increase in agricultural production. Whereas the inquiry specifically set out to determine the possibilities of expanding land settlement, the conclusions must relate to increased production, whether from new or existing producers. Is it unfair to presume that the same conclusions would have been reached by the same authors four years ago? We think not, for the arguments applied then as now. Yet they have been entirely falsified. Production has increased, agriculture has received considerable benefit, and neither the cost of living nor our export trade has suffered.

Although the authors prove to their satisfaction that it is illusory to suppose agriculture offers a promising outlook for the absorption of large numbers of unemployed, this is not really the case at issue. It is true that there are some who dream of settling a million men on the land of Great Britain, but those with responsible knowledge know full well that such a policy is bound to remain a dream. It is quite unnecessary to argue that it is undesirable because of the increased food production that would result. Even this is not necessarily certain, and in any event land settlement is an experiment in men and management, not an experiment in farming or in increasing food production. It is equally unnecessary to condemn such endeavours as can be made to meet local demands and social needs for land settlement in carefully selected areas and with carefully selected men. The whole world situation may well have changed long before such a policy leads to any dilemma of over-production from this cause.

Again, many of us think that such a report, based on discussion of general principles and setting forth conclusions, the limited application of which may not be realised by the general reader, is doing definite harm to the cause of agriculture as a whole. Lord Astor has pursued a similar course before. When limited assistance to wheat-growing in Great Britain was introduced, he reviewed the position of wheat-growers as a whole in the world and this country and spared no pains to convince the general public that any assistance to British wheat-growers was unsound in principle and in practice. Even in the book now under review the old subject is introduced by the arbitrary statement, "Wheat is marked out by the peculiarities of the British climate as a commodity which is appropriate for us to import largely from abroad". It is a pity that the authors of such statements cannot review the intricacies of British agriculture as a whole. They might then well come to the conclusion that "Wheat is marked out by the peculiarities of British farming in certain districts as a commodity which it is not only appropriate but necessary to grow as the basis of arable cultivation until such times as some other crop of like nature appears to take its place". This habit of taking some agricultural measure in theoretical argument to its extreme and then condemning it, ignores the complexity of the agricultural structure and the urgent need to strengthen each separate section by suitable and often diverse means, each designed for its own specific purpose and often strictly limited in either its time or area of application.

Apart from all these general considerations, the whole 'agricultural dilemma', as set forth in this book, ceases to exist if consumption of foodstuffs in Great Britain can be increased. Such a possibility is somewhat lightly dismissed; for example, "There is a possibility that consumption might be increased by better marketing arrangements, but there is no indication that the reforms proposed would result in economy sufficiently large to stimulate consumption materially". Again, "The operations of the statutory marketing boards, which represent the existing experiments in the improved marketing of agricultural products, are not in the main of a character calculated to promote the growth of consumption . . . if, for example, the consumption of one-fifth of the population were increased by 20%, the aggregate consumption of food by the community would be increased by only 4%". On the other hand, it is admitted that "Measures that would increase the aggregate consumption of food would meet what is probably the chief need of the economic situation".

This last sentence, in our view, counteracts the whole argument of the book, and the previous quotation regarding marketing boards and the possibilities of increased home consumption by no means tells the whole story. We know that marketing boards during the first months of their existence have not been able to devote much time to the reduction of marketing costs and to increasing consumption, but that is because they have been primarily engaged in saving the livelihood of the industries which elected them. Their existence to-day provides the best opportunity of action being taken along the required lines, and evidence is daily accumulating that they are fully alive to these responsibilities. Then as regards the possibility of increased consumption the figures quoted are definitely misleading. The dietary of at least 20 million persons is markedly deficient from the point of view of health. To raise it to that consumed by families with total incomes of only 20*s*. a head a week involves an increased consumption of ten per cent; to raise it to the standard of those with 25*s*. a week income would involve an increase of twenty per cent, that is, at retail prices some £200,000,000 more would require to be spent on food. As Sir John Orr has pointed out, to bring consumption up to that of families with incomes of 35*s*. a head a week (£335 a family per annum) would call for an increased consumption of 42 per cent of milk, 27 per cent butter, 28 per cent eggs and 53 per cent fruit and vegetables. At present only the wealthiest ten per cent of the population approach the standard of one pint of milk a person each day which medical opinion holds is adequate, the national average being rather less than three pints a week. To bring the entire population up to the ideal would wipe out the whole surplus and create a very severe milk

famine, which could only be brought to an end by a fifty per cent increase in output.

These may be dreams of perfection, but is it correct when the authors of this report imply that the possibilities in this direction are limited? If we can correct malnutrition—this glaring mistake in our national life and national economy—then the agricultural dilemma vanishes: fears of over-production can be relegated to the distant future.

Few will quarrel with the conclusion that the settlement of vast numbers of unemployed on the land is impracticable. This book, however, bids us believe that any considerable increase in home production, from whatever source it arises, is impracticable. Such a statement we submit is unsound and definitely harmful to the cause of agriculture.

In saying this we wish particularly to add that no one could possibly imagine that Lord Astor and every one of his colleagues responsible for the inquiry do not sincerely and profoundly desire to see renewed prosperity reaching the English countryside. They themselves state that they arrived at their conclusions with very great disappointment. The reviewer, while feeling bound to attack these conclusions with all the force at his command, consoles himself with the thought that, if his view is correct, then the authors' disappointment can vanish with the dilemma which they have conjured up. The real problem before the country is to increase consumption of home foodstuffs to the mutual betterment of agriculture and of national health. W. GAVIN.

A New "Outline"

Science: a New Outline
By J. W. N. Sullivan. Pp. xii+286+4 plates. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1935.) 5*s*. net.

IT is perhaps insufficiently recognised that the writing of a good "Outline", of the kind which the public, or the publishers, seem to go on demanding, is a vastly more difficult task than the writing of a good monograph. The ratio of difficulty is that of Dürer or Cézanne to the village photographer. Dürers and Cézannes being scarce, it is a natural consequence that most "Outlines" are disappointing and few wholly satisfying. Mr. Sullivan has on previous occasions demonstrated his understanding of modern scientific thought and method, and his present "Outline" is an interesting and readable assemblage of usually accurate information from the physical and biological sciences. There is a gallant attempt to carry the pencil on without discontinuity from the physical to the biological, and the author may be congratulated on his general success in this difficult undertaking.

But whether Mr. Sullivan and his publishers are doing a service to 'science' in this new outline is very doubtful. Too frequently the reviewer sees in it a highly intelligent Jack Horner, pulling out of the scientific pie a number of attractive plums which are chosen merely "pour épater le bourgeois". It would be much better for the consumer to be told how and why the plums got there than to have them pulled out ready-cooked.

The plum-pulling encourages carelessness in the author. The most worthy of his chosen audience will stop at every third page to ask about the how and why, and will find no answer in this outline He will be repelled by the slovenliness of exposition in the introductory note, of "a certain very simple notation which is universally adopted by scientific men", in which one-millionth = 10^{-6}. He will wonder what is really meant when the polar diameter of the earth is stated to an accuracy of fifty feet. He will probably know enough to see that he is being misinformed when the aeroplane height record is implicitly put so low as seven miles; he will probably *not* know enough to see that he is being equally misinformed when he is told that "at something over sixty miles the atmosphere is almost entirely composed of hydrogen . . . while oxygen seems to disappear completely". He is not unlikely to be surprised by the author's neglect of the main factor in a simple problem in statics. Mr. Sullivan says, "Whenever we crook a finger all the hosts of heaven are affected", and goes on to use the inverse square law to mitigate the disturbance. An intelligent schoolboy will be able to tell him that a much more important reason why the hosts of heaven are substantially indifferent to one crooked finger or ten million extended right arms is that the earth side-slips to counter the crook.

These are small specimens from early pages, but they are representative of that culpable lack of care which is dangerously common in works of popularisation. It is culpable and dangerous because, in sum, the world will remain unfit for civilisation so long as the reader of "Outlines" is fed on the facts of science untempered by an education in its stringent honesty of aim and method. W.

F. H. Bradley's Psychological Principles

Collected Essays
By F. H. Bradley. Vol. 1. Pp. x+347. Vol. 2. Pp. v+349–708. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 36*s*. net.

THESE two imposing volumes are a very welcome addition to philosophical and psychological literature. It is true that with two exceptions all the essays here included have already seen the light. But each of the pamphlets containing the opening papers of the present collection —those on "The Presuppositions of Critical History" (the author's earliest production) and on "Sidgwick's Hedonism"—have long been out of print, and the other published articles have remained more or less buried in the back numbers of the periodicals in which they first appeared.

Bradley was the author of several epoch-making works in the fields of ethics, logic, metaphysics and epistemology; and some of the papers in the volumes before us deal with ethical questions. But, although he was a psychologist of rare independence and insight, he did not write any separate book on psychology; he was content to let his psychological contributions appear as articles in the pages of *Mind*. These occupy by far the larger, and I think it may be said the more important, part of the new volumes now under notice.

It was perhaps unfortunate that Bradley should have persisted in designating the point of view which seemed to him the right one in psychology as that of "phenomenalism", because he was using the term 'phenomenon' in a peculiar sense (familiar to readers of his work "Appearance and Reality"), whereas it usually carries with it implications which he would have repudiated. What, however, he meant was that the mere course of psychical events as such, happening and experienced within a single organism, and the laws of coexistence and sequence between these events, constitute the subject-matter of empirical psychology, while questions about the ultimate nature of mind or soul do not belong to its domain. He was trying, as he himself expressed it, to work in the spirit of the best English tradition (and, one may add, of the best Herbartian tradition), although rejecting absolutely the doctrine that had become associated with it of 'psychical atomism', and refusing to admit what had been so often taken for granted that *all* psychical facts can be treated as objects to be observed.

The association psychology went into bankruptcy, it has been said, when J. S. Mill felt himself compelled to suggest the hypothesis of 'mental chemistry'; and in the later decades of last century a new phase of psychological theory was taking its place. So far as stress was laid in the latter upon the primary importance of evolution or development in the mental life Bradley was in complete accord therewith. But he found in the writings of its two most prominent exponents, Wilhelm Wundt and James Ward, an underlying notion of the nature of mind which appeared to him not only unpsychological but also devoid otherwise of justification. Ward had laid it down, namely, that for psychology, as the science of individual experience, the duality of subject and object is fundamental and primordial. On one side, he maintained, is the active subject, with its one primitive capacity—that of feeling—and, on the other side, are the objects of its activity, the presentations attended to. And since the feeling agent, that is, the knower, and the known are antithetic and distinct, direct presentation or representation of feeling and activity must be alike impossible; we can know of these only mediately through their effects, through certain changes which they bring about in the character and succession of our presentations.

Whether one agrees with it or no, Bradley's criticism of the positions just indicated must be allowed to be searching and penetrating. He argued that to interpret the consciousness of force or energy as being itself a mode of exerting, or putting forth, force or energy is wholly illegitimate. He denied that this consciousness is in any sense a revelation of activity or energy, as an unanalysable element. It gives us, he urged, not a fact but an intellectual construction, and a thoroughly baseless intellectual construction. The notion of an arbitrary force proceeding from the self is, in truth, he contended, a notion to which no intelligible meaning can be attached. Not only so. It seemed to him that no valid reason whatsoever had been offered for assuming that the relation of subject and object is implied in all conscious experience. It is, he averred, inconceivable that experience at its poor and blurred beginning divides itself into two parts with a relation between them. Until the primitive whole of feeling becomes to some extent differentiated into feelings, and until within this whole a core had grown together, over against which different groups of presentations can come to appear as an 'other', it is, he

insisted, impossible to see how there can be any aspect of *self-feeling*, and still less how there can be anything like what is ordinarily meant by subject and object. In short, what I take Bradley's contention to be amounts to this, that the general terms "subject" and "object" have their meaning fixed only in and through the concrete experiences which enter into and serve to establish a recognised distinction between them.

Starting, then, with a conception of the beginnings of mental life such as he held we are warranted in framing, Bradley's constructive work in psychology consisted in endeavouring to trace the way in which the several so-called faculties of mind—attention, thought, will, and so on—gradually came to be. Thus, in dealing with attention, he shows, in the first place, how the process of involuntary attention may be regarded as having been initiated by differences in the intensity of feeling-tone accompanying certain presentations, the latter thereby attaining predominance in consciousness. And he tries, in the second place, to make manifest how from the undoubted facts of involuntary attention an intelligible account of the emergence of active or voluntary attention can be given without calling to our aid the idea of some mysterious "force" proceeding from the self. Briefly, it is with the rise into consciousness of a definitely recognised distinction between the self and the not-self that there become possible those experiences of strain or effort which characterise attention as we are familiar with it. Whilst recognising the influence of muscular and motor factors, Bradley conceived that the origin of the experiences in question lies in what he called a feeling of expansion consequent upon the enlargement of the self. When we get to know from repeated experience that changes ensue upon modes of our self, this expansion of our area, beginning from within, gives the feeling of activity.

The chief characteristic of conceptual thought, as regards its content, is, Bradley contended, objectivity; and, pursuing still the genetic method, he sought to render explicable the transition to thought from feeling or sentience by resort to the theory of Association, but that theory radically modified. Not only is atomism wholly banished, and with it likewise the "law of similarity"; but also the law of contiguity has to be so restated as to make it depend always on identity of content, not of existence. The law then becomes that of Redintegration, expressible in the form "every mental element when present tends to reinstate those elements with which it has been presented". Further, there is to be postulated what he called a law of Blending or Fusion—the law, namely, that "where different elements (or relations of elements) have any feature the same, they may unite wholly or partially". Lastly, underlying these two laws there is to be discerned, so he argued, one principle—the principle which may be described as that of Individuation, according to which "every mental element strives to make itself a whole or to lose itself in one"; or, in other words, "tends to give itself a context through identity of content". Such was the "machinery" which, working in all psychical processes, appeared to Bradley adequate to account for the fact that from a basis of mere feeling the development of thought, as the apprehension of something real by itself and independent of its connexion with a feeling-centre, emanates.

In a similar manner Bradley endeavoured to trace the genesis and development of volition or will. Obviously, will, involving as it does the consciousness of self, cannot be regarded as original or ultimate. It can be no other than a product or result from that which by itself is not volition. Its essence, on Bradley's view, consists in the passage of an idea into existence; and that passage depends on machinery—the machinery already alluded to. If an idea works itself out ideally and subject to identity, we have the process of thought. If, on the other hand, it produces fact, if it alters the existent object into accordance with its own character, the process is will; and unless the idea carries itself out into the changed existent there is no will.

My space is exhausted, but I may perhaps be allowed to indicate the sort of difficulty I feel in regard to the assertion just mentioned. If by 'idea' be meant, as I take it was meant, a content apprehended, then one may well ask whether an 'idea' ever does 'carry itself out'. The carrying out of what is willed, so far at least as that involves a change in the outer world, is surely a bodily affair, the details of which, as Lotze pointed out, entirely escape the consciousness of the willing subject. Indeed, I am possessed of an uneasy suspicion that having, as I think, rightly refused to picture consciousness as exerting force or energy, Bradley tended to transfer this notion to 'presentations' and 'ideas'; and to imply, after the manner of Herbart, that although a 'presentation' or 'idea' taken *per se* is not a force, yet a number of 'presentations' and 'ideas' when in conjunction do operate on one another as though they were forces.

Despite, however, the criticism they will certainly elicit, no competent judge will hesitate to acknowledge that these essays together form an extremely valuable contribution to psychological science. The volumes have been most carefully edited. They only lack one thing—an adequate index.

G. DAWES HICKS.

Gmelins Handbuch der anorganischen Chemie

Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 35: Aluminium. Teil A, Lief. 2. Pp. 285–450. 26 gold marks. Teil B: Die Verbindungen des Aluminiums, Lief. 2. Pp. 309–613. 49 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1934.)

THE well-known property possessed by aluminium of coating its surface with an invisible, firmly adhering and continuous skin of oxide has rendered the systematic investigation of its electrochemical behaviour extraordinarily difficult, while at the same time it has had most important practical results in the industrial application of the metal. Thus the properties of pure aluminium may be very different from those of the commercial metal. Accordingly, about one quarter of Part A, Section 2, of the volumes on aluminium is occupied with a discussion of electrochemical measurements. The remainder deals with the chemical action on aluminium of non-metals, water, acids and alkalis, including organic reagents.

Part B, Section 2, deals with a large variety of compounds of aluminium, including the silicates and the changes which kaolin undergoes when subjected to heat, natural and synthetic zeolites, the various alums and ultramarines. Historical accounts of the uses of alum and ultramarine are given. The latter has been in use as a dye since the eleventh century. Recent work upon its constitution has shown that in all ultramarines the ratio $SiO_2 : Al_2O_3$ remains practically constant in the silicate frame, and the colour depends not only upon the sulphur which is present but also upon the alkali. The latter can be partly or almost completely extracted from blue ultramarine by means of chlorine and certain organic solvents. The colour is thereby destroyed, but it can be restored by the addition of alkali. When chlorine was used it was found that the colourless product retained the original crystal lattice structure.

Chinese Art

Edited by Leigh Ashton. Introduction, by Laurence Binyon; Painting and Calligraphy, by Laurence Binyon; Sculpture and Lacquer, by Leigh Ashton; The Potter's Art, by R. L. Hobson; Bronzes, by A. J. Koop; Jades, by Una Pope-Hennessy; Textiles, by Leigh Ashton. Pp. xvi + 111 + 23 plates. (London: Kegan Paul and Co., Ltd., 1935.) Paper, 2*s*. 6*d*. net; cloth, 3*s*. 6*d*. net.

THIS little book, which has been prepared in anticipation of the exhibition of Chinese art being held at the Royal Academy, Burlington House, does not call for extended comment, excellent though it is. It is intended for the uninitiated, and has been written by experts in the respective fields with which each deals, as indicated in the title-page. The essays are short, but have been skilfully adapted to their purpose of giving the Western visitor to the exhibition an idea of the Chinese artistic and technical achievement, as well as of the mentality and range of imagination of the Chinese artist. The dynastic and chronological relations of the exhibits—of the first importance in the appreciation of Chinese culture—receive due attention. The book is liberally illustrated.

Modern Production among Backward Peoples

By Dr. I. C. Greaves. (London School of Economics and Political Science: Studies in Economics and Commerce, No. 5.) Pp. 229. (London: George Allen and Unwin, Ltd., 1935.) 10*s*. 6*d*. net.

DR. GREAVES has broken new ground in her study of the economic activities and organisation found among backward peoples as the result of the introduction of European methods of exploitation of their resources. The data she has collected, as well as her conclusions, are of interest to economist, anthropologist and administrator alike. For the anthropologist they form an object lesson in culture contact, available equally for academic use and practical application: for the administrator, a message of guidance and warning; and for the economist, in the author's attitude to cultural differences, a new orientation in the assessment of comparative values.

Dr. Greaves passes under review the function of the State in administering backward territory in relation to imports, exports and the investments of capital from outside sources. She shows how, still keeping this triple aim in view, policy has changed direction from promoting the interests of the European, whether settler or ruling people, to a substantial, if not exclusive, support of indigenous activity. How far this is general depends upon local conditions, and all stages of development are to be found, going indeed so far in one direction as the complete segregation which is the ideal, not, however, realised in practice, in South Africa.

A wide variety of economic problems has been brought under review by the author, and her book is a store of information, as well as a well thought out and impartial survey of conditions and tendencies.

Low Temperature Physics

By Dr. L. C. Jackson. (Methuen's Monographs on Physical Subjects.) Pp. vii + 122. (London: Methuen and Co., Ltd., 1934.) 3*s*. net.

UNTIL quite recently, the development of low temperature research has been carried on almost entirely abroad, and although the book has had to be restricted to a few sections of especial interest and, in particular, dealing largely with the range of temperature 1°–20° abs., a remarkably comprehensive survey is compressed into the six chapters on the production of low temperatures, their measurement, liquid and solid helium, specific heats, electrical conductivity and magnetism. The latest work on the region below 1° abs. is notable, and, in view of the interest and importance of electrical and magnetic phenomena at low temperatures in connexion with atomic and lattice structure, the last two chapters give a valuable summary of recent experimental and theoretical advances.

Although the book is mainly concerned with the description of experimental technique, given in many cases with illustrative curves and numerical data for a large number of substances, the mathematical theory and expression of the various aspects of the subject are not neglected. References to more than a hundred original papers are provided. N. M. B.

Hydrogenation of Coal

IN a country which had formed the habit of assessing power in terms of coal-burning in a furnace or under a boiler, the decline in the coal mining industry and the rapid expansion in the use of the internal combustion engine are two facts about which chemists and engineers have been thinking for a long time. Interest in the production of petrol from coal is now nation-wide; it has been stimulated by the hope—indeed by the conviction—that this branch of chemical industry will appreciably help British coal mining to surmount its financial difficulties, bringing work and wages into many homes that have long known neither; and it has been maintained by the success which Imperial Chemical Industries, Ltd., has already achieved in placing the operation on a commercially promising basis. For that reason alone, and apart from its obvious technical interest, Mr. Kenneth Gordon's lecture on November 21 to the Institute of Fuel, entitled "The Development of Coal Hydrogenation by Imperial Chemical Industries, Ltd.", deserves to be regarded as an event of more than passing significance.

Mr. Gordon reminded us that there are three types of reaction to be distinguished. First, there is the transformation of impure carbonaceous material into hydrocarbons, other elements being removed in the form of their compounds with hydrogen, that is, as water, ammonia and hydrogen sulphide. Then there is the saturation with hydrogen of unsaturated bonds between carbon atoms. Finally, there is the splitting up by heat of the saturated molecules so formed to give light hydrocarbons, although a certain amount of hydrocarbon gas, and even of coke, is also formed, particularly when the saturation has been inadequate. "The art of hydrogenation," Mr. Gordon said, "consists in choosing the proper conditions of temperature, pressure, time of reaction, and catalysis, so that the three desired reactions take place to the greatest extent, and the fourth reaction, the undesired formation of gas, to the minimum extent." In practice, pressures of at least 200 atmospheres, and temperatures of 300°–500° C. are employed, suitable means being used to dissipate the heat liberated during the chemical reaction; the catalyst may be mixed with a liquid, or vapours mixed with hydrogen may be passed over it. The choice of a catalyst is governed by its activity in promoting the hydrogenation reaction, the thermal decomposition ('cracking') reaction, or both, and its susceptibility to inactivation ('poisoning') by certain materials, for example, sulphur, often present in the original coal or oil.

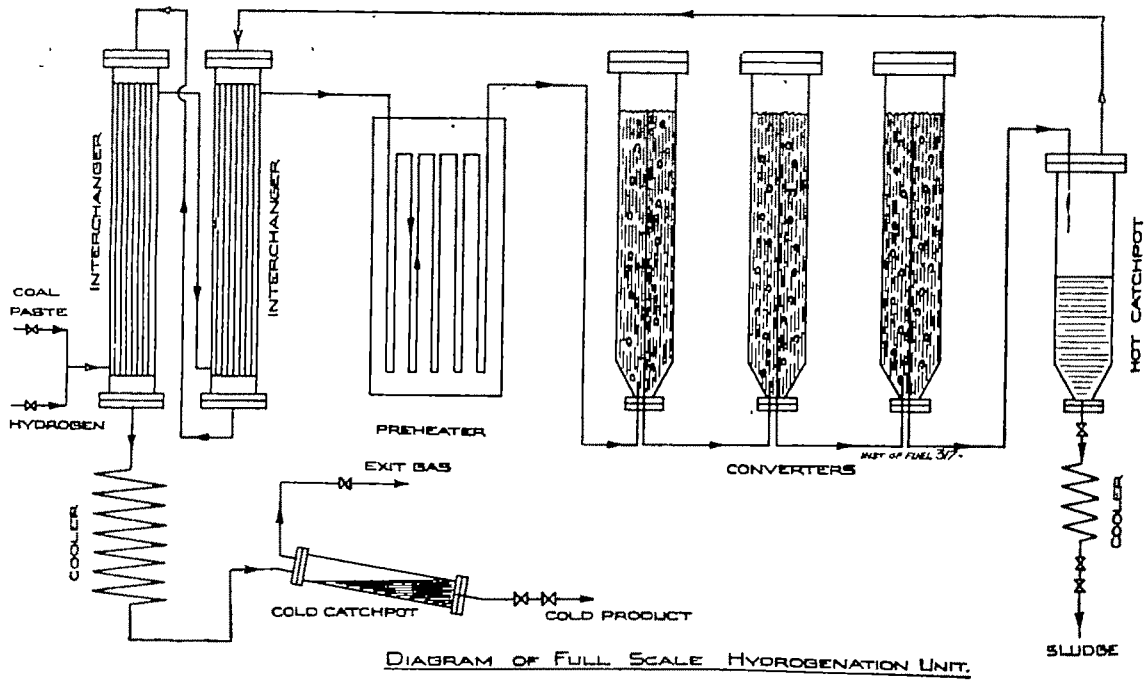
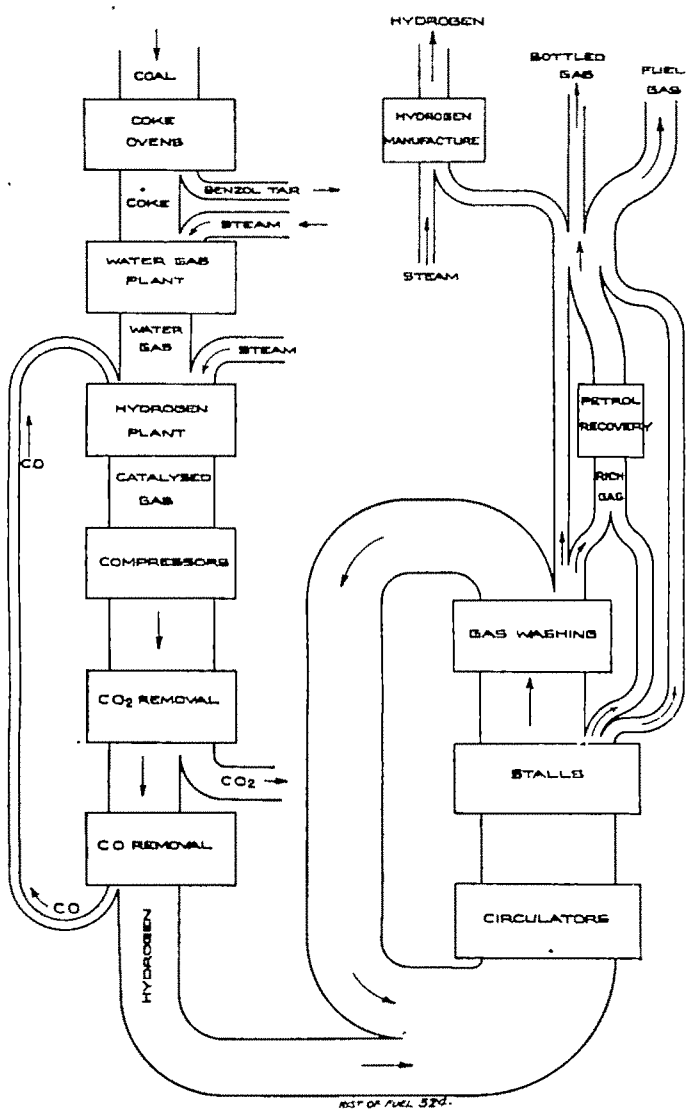


FIG. 1.

The solution of this important problem was an essential preliminary to any advance in the direction of commercial hydrogenation.

The original Bergius process, as developed by the German combine known as the Interessen Gemeinschaft für Farbenindustrie, or more briefly as the "I.G.", working at first independently and later in association with the Standard Oil Co. of New Jersey, afforded as products petrol, tar acids, heavy oil and pitch. Tests on British coals were carried out, but it was soon decided by Imperial Chemical Industries, Ltd. (equally well known as "I.C.I."), that modification in the direction of the production of petrol alone was desirable. Experiments were commenced at Billingham in 1927, and a plant treating 10 tons of coal a day was operated from 1929 until 1931. Following a demonstration in 1930 that 60 per cent by weight of petrol (a figure since exceeded) could be obtained from coal, the formation, in 1931, of the International Hydrogenation Patents Co. (a company formed by the "I.G.", "I.C.I.", the Standard Oil Co. of New Jersey, and the Royal Dutch-Shell Group) placed the interested companies in a very strong patent and technical position. During 1932 technical advances were being made, and schemes for operating on a large scale were maturing; so that when, in 1933, the British Government announced its intention to protect the new industry by guaranteeing the continuance of a preference for a term of years, Imperial Chemical Industries, Ltd., decided to proceed at once with the erection of a plant at Billingham.



FLOW DIAGRAM OF HYDROGEN PRODUCTION & TREATMENT OF HYDROGENATION PLANT GASES

FIG. 2.

Preliminary scientific work has, of course, been enormous in its extent; a million pounds were spent in this way between 1927 and 1933 by I.C.I. alone, but few details relating to it have appeared in the scientific literature by reason of arrangements made with the international company. It has been found possible on a large scale to dispense with mechanical stirring and external heating; tin, first used in the form of tinned iron plates, and later in the form of certain organic compounds, was found to be the most promising catalyst. The "Billingham" method of using two vessels, one inside the other, has been employed; thus one vessel withstands the temperature but not the pressure, whilst the other withstands the pressure and not the temperature.

The process affords petrol, middle oil and heavy oil; the heavy oil is recirculated with coal, but the middle oil has to be subjected to hydrogenation in the state of vapour. Cleaned coal is found to be much more satisfactory than raw coal, partly because it avoids the expense of processing mere ash, but partly also because the alkaline ash interferes with the catalytic reaction. The residual ash can be neutralised by the addition of hydrogen chloride now that its subsequent removal (in order to prevent corrosion) can be accomplished by scrubbing the hot vapours at 450° C. with a suspension of alkali in oil.

On the large scale, the hydrogenation of coal is at present associated with that of creosote oil, supplied by tar distillers, and of low-temperature tar; but if market conditions require, small adjustments to the plant will adapt it to the desired

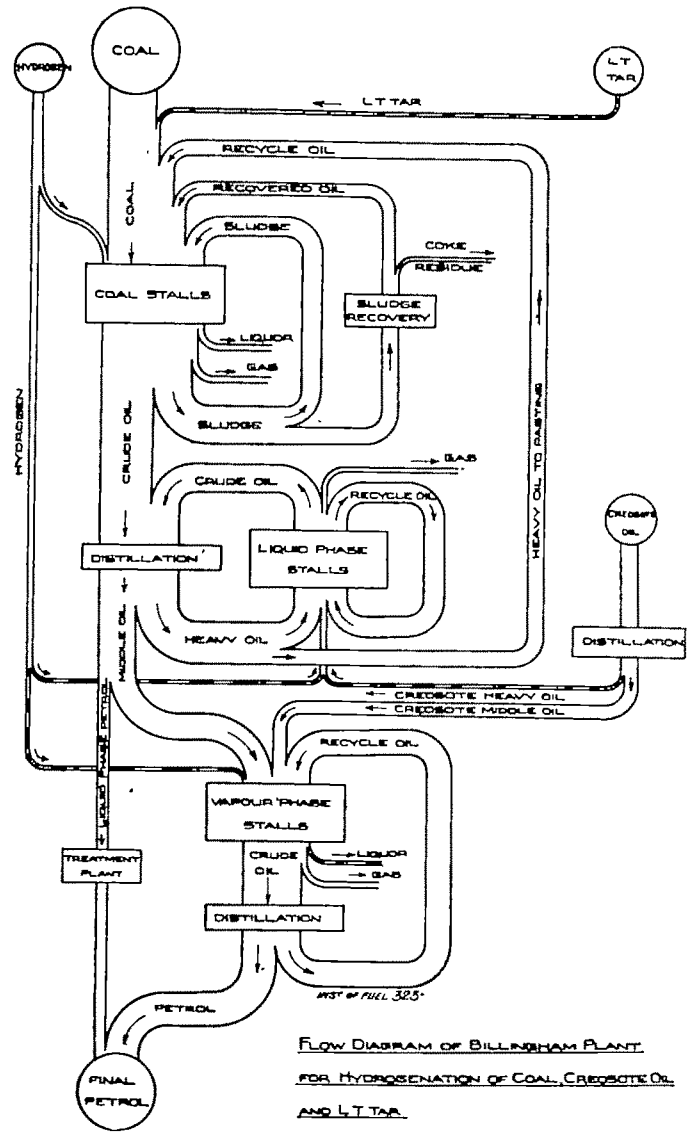
extent for the treatment of coal. In fact the Billingham plant is deliberately designed to provide for flexibility. The hydrogen comes from coal by way of coke and water-gas, but it is intended to manufacture hydrogen from waste hydrocarbon gases by catalytic treatment with steam instead of using these gases as fuel. Part of the waste gas is, however, already used commercially; liquefied butane is supplied for sale for domestic purposes where coal gas is not available.

The process is operated as follows: The coke, from coke ovens, is used for making water-gas, which is freed from sulphur, and then treated with steam in the presence of a catalyst to afford a mixture of hydrogen, carbon dioxide and a little carbon monoxide. This gas is compressed, freed from carbon dioxide by scrubbing with water at 50 atmospheres, and from carbon monoxide by scrubbing with a copper solution at 250 atmospheres pressure. The hydrogen circulating in the plant becomes contaminated with nitrogen and hydrocarbons; these are removed partly by dissolution in the products themselves (being recovered on release of pressure) and partly by scrubbing with oil under pressure.

Coal, first freed from dust by air and then cleaned by the Chance process (of floating the raw coal on a suspension of sand in water), is ground up, together with the right amounts of catalyst and oil, into a paste; the oil used for this purpose is the heavy fraction of creosote oil. This fluid paste, containing 50 per cent of coal, is injected against a pressure of 250 atmospheres, and becomes mixed with hydrogen, being brought to the reaction temperature first in heat exchangers and then in gas-fired pre-heaters. After passage through the converters the product is separated into gases and vapours on one hand and residual oil, ash and coal on the other.

The units, or 'stalls', comprise converters, heat exchangers and pre-heaters, which are arranged in one line and tended for maintenance by a Titan crane of 170 tons capacity; each pair of stalls has a control room containing the instruments and valves. The gas released from the crude products by the removal of pressure in stages is separated into 'lean' and 'rich' gas, the latter being further treated for recovery of the light fractions of petrol. All petrol is washed with caustic soda to remove hydrogen sulphide, and is stored under nitrogen; liquid phase petrol requires treatment with sulphuric acid as well.

It is estimated that the over-all consumption of raw coal would, on a new plant, be 3·5–4 tons per ton of petrol; the thermal efficiency is 40 per cent, whilst that for the generation of electric power is 25 per cent, and that for gasification is 55 per cent. In the Billingham plant, the over-all raw coal consumption is 5 tons per ton of petrol.



FLOW DIAGRAM OF BILLINGHAM PLANT FOR HYDROGENATION OF COAL, CREOSOTE OIL AND L.T. TAR.

FIG. 3.

The petrol is of uniformly good quality, and has a high volatility. Concluding his paper, Mr. Gordon remarked that the company has not had much time to study the production of Diesel oil from coal, but that there is no insuperable difficulty in producing a satisfactory oil. Heavy oil obtained from coal is suitable for use as fuel oil without further treatment; whilst the problem of lubricating oil manufacture still awaits attention.

Some Geological Aspects of Recent Research on Coal*

By Prof. H. G. A. Hickling

Types of Coal Aggregate

In coal, as in other fragmental rocks, size is the great sorting factor. The dominating component, vitrinite, exists for the most part in fragments much larger than those of any other component except fusain. It follows that as the average size of the particles in any coal aggregate decreases, so the proportion of vitrinite usually becomes less, while that of spores, cuticles, resins, fragmented fusain and residuum becomes greater. This introduces an important element of order where there might have been almost complete chaos.

Complete gradation from the brightest coals, consisting entirely of large fragments of vitrinised tissue —that is, of vitrain lenticles only—through every stage of decreasing particle size, decreasing vitrinite content and decreasing lustre, to the most finely granular dull aggregate is to be expected and is easily found. But in most seams there is a small proportion of bands ('durain') which are unmistakably quite without lustre, and these are sharply separated from the 'bright' coal ('clarain' and 'vitrain'), even though the lustre of the bright bands may vary widely. The distinction of the two types of aggregate clearly corresponds to some difference in the mode of accumulation.

The really dull bands are usually (though not necessarily) characterised by a very much higher content of ash than the bright coal, and this excess always consists of a very fine clay which must have been water-borne. Both durain and clarain are of variable composition, and the one may shade into the other though they are commonly somewhat sharply separated. The clarain, however, with its dominating vitrinite constituent, tends to comparative uniformity of composition, while the durain may be far more varied. A rich content of spores, cuticles or resins may make the durain conspicuously rich in hydrogen; while a dominance of residuum, or a high content of fragmented fusain, may have the opposite result. It is the variable part of the coal.

Rank of Coals

From the geological point of view, the greatest contribution which is made by the microscope to the study of coal is, that it enables us to determine definitely whether the difference in quality of two coals can or cannot be attributed to original difference of composition. If they can be seen to consist of entirely similar plant materials in a similar state of preservation, then any considerable difference in quality must be attributed to some other factor. Conversely, we may compare the quality of coals which are visibly composed of different materials, and find what are the constant differences between them. The differences due to plant ingredients and mode of origin define the *type* of coal; those due to subsequent alteration denote the *rank*.

Composition of Coal Components

In common with most vegetable substances, coals consist mainly of carbon, hydrogen and oxygen, and as the first step in the discussion of this problem we may inquire how the proportions of these constituents vary among the different plant materials which may be isolated from any single piece of coal. The vitrinite is of very uniform composition. The group of cuticles, spores and resins is notably high in hydrogen, but is not exceptional in the ratio of carbon and oxygen. Any fusain present will be very deficient in both hydrogen and oxygen. The chemical composition of the residuum needs further investigation; the indications are that it is usually a little deficient in hydrogen and oxygen, but not to such an extent as in the case of fusain. The outstanding fact is that the different components vary strikingly in their hydrogen content (from about 3·5 per cent in fusain to 8·0 per cent in some spores), while only in the case of fusain is there any notable variation in the oxygen.

Now, if we take a very large number of representative analyses of lignites and bituminous coals (but exclude for the moment anthracites and cannels) we shall find the limits of variation of the chief constituents to be approximately as follows: hydrogen, 4·5–6·0 per cent; carbon, 65–90 per cent; oxygen (varying in almost exactly complementary proportion to the carbon), 30–5 per cent. We see clearly that the whole variation of hydrogen content is well within the range observed among the different plant constituents in a single piece of coal. But the observed range of oxygen content in different coals is, on the contrary, many times greater than could be produced by any known variations of the plant constitution. It is this difference of oxygen content, in fact, which chiefly denotes the *rank* of the

* *Continued from p.* 819.

coal, distinguishing the lignites, bituminous coals and anthracites.

A very significant feature of this variation in rank is the fact that it is *continuous* throughout its long range, and the significance of this continuity is emphasised in an interesting way by the work of Prof. Bone and his colleagues, who have shown that the proportions of the different types of organic compounds present in the coal vary progressively throughout the series.

SIGNIFICANCE OF RANKS

The thesis towards which all my remarks have been preparatory is that the rank of a coal is the measure of the alteration in composition which the deposit has suffered in consequence of the rise of temperature and increase of pressure resulting from its burial in the crust.

What do we know of the relation between the rank of coals and their distribution in the rocks ?

The fact which appears to me to establish most clearly that change of rank must be caused by some geological factors is its areal distribution. In every coalfield where substantial variation of rank has been noted and examined, the rank of any given seam is found to change *progressively* as it is followed across the field. If the variation be plotted on a map by means of lines representing volatile content, carbon content, or any suitable measure of rank, these lines are found to be arranged in an orderly pattern and—this is the important point—the same pattern is repeated by each seam within the area. Wherever the rank of one seam is increased, there also is that of the others. Whatever cause has affected one has affected all.

Valuable light is shed on this matter by the detailed information concerning the composition of many of our own coal seams and their variation which is being accumulated by the National Fuel Survey. Many of the seams examined, particularly in Northumberland and Durham, show large changes in rank as they are followed across the coalfields. Some of the seams are notably 'bright' coals, with a relatively high hydrogen content; others contain a larger proportion of durain and (commonly) a lower percentage of hydrogen. A careful comparison of the analyses shows clearly that the seams which are high in hydrogen retain that peculiarity regardless of change in rank, while those which are low remain low. The chemical evidence supports that provided by the detailed examination of the physical peculiarities of the seams, and the cumulative evidence leaves no room for doubt that in these instances the change of rank is quite independent of the original constitution of the seams.

HILT'S LAW

The simplest and most familiar evidence of a relation between rank and geological conditions is Hilt's law: that, in any single vertical section, the deeper seams are of higher rank than the upper seams. Apparent failure of the rule in some cases is doubtless due to the fact that original differences between seams may affect their present composition to a greater extent than small differences of depth. But when the differences of depth are substantial, exceptions are rare.

The value of Hilt's law lies, first, in the fact that it is unambiguous in its significance, and, secondly, in the fact that since we know something of the increments of temperature and pressure which correspond to given differences of depth, and can compare these with the changes of rank produced, it gives us the data necessary to reverse the process, and to consider the rank of coals as an indication of the temperatures and pressures to which they have been subjected. The temperature increments are clearly so small that most geologists have been inclined to attribute the effects mainly to pressure. It is impossible to discuss this matter within the limits of this address, so it must suffice merely to refer to the experimental work, which has shown how readily coal, even in its present condition, yields volatile products at very moderate temperatures, and to the fact that in the effects of igneous intrusions we have a series of beautiful natural experiments in the alteration of the rank of coals by heat alone. In some of these natural experiments the resultant effects on the coal appear to be in every respect analogous with the ordinary changes of rank; in others they are obviously different. In the latter instances it is not difficult to see that the results are due to the rapid application of somewhat considerable increments of temperature. There appears to me to be quite good evidence to show, on the contrary, that in those cases, in which considerable changes of rank of the normal type have been produced, the total increments of temperature have been quite small.

If it be true that the rank of coals has been determined mainly by the depths to which they have been buried, then it is natural to look for some relation between the varying rank of any seam and its present depth below the surface, or to relate the variation to axes of folding. Much has been written on this subject, and completely contradictory conclusions reached. But this is to be expected. The coal can only indicate the *maximum* temperature or pressure to which it has been subjected, since change of rank is almost certainly an irreversible process; decrease of temperature and pressure will not restore it to its former level. Now a little reflection will show that, after the completion of the coal-bearing series, the most

general result of subsequent folding will be elevation and denudation, leading to a decrease rather than an increase of load. In so far as this is true, the folding will not be reflected by any variation of rank; while, on the contrary, any circumstance which does lead to a further increment of temperature will leave its mark. Later burial of the whole series below an uncomformable cover may lead to a change of rank in the deeper parts of the seams, while leaving the upper portions untouched. The time factor, moreover, can by no means be left out of account. Geo-isotherms creep with exceeding slowness, even in terms of the rate of sedimentation and denudation. The duration of burial as well as its depth is therefore material. In fact, the whole sequence of events which have determined the maximum temperature and pressure reached at any point must have been much too complicated to be readily decipherable from the present disposition of the rocks.

In all these complications, however, one cardinal principle remains. At any given place, both temperature and pressure must always have increased downwards—apart, of course, from the influence of igneous intrusions. So, while the interpretation of the lateral variation of rank is involved in many complicating factors, Hilt's law remains as a simple and significant sign. Even in this case the significance is liable to be obscured by the variation of the original coal substance of the different seams; but the technique of the microscopic study of coal has now reached the point at which, I believe, the effect of this factor can be almost completely assessed and eliminated. If this be so, then we are in a position to use coal as a geological thermometer—or, perhaps, combined thermometer and barometer—and we may set about calibrating it by means of a thorough study of Hilt's law and of the effects of igneous intrusions. But we must never forget that the thermometer has one peculiarity—it is a maximum thermometer only.

Obituary

Prof. Sylvain Lévi

THE death is reported from Paris of Prof. Sylvain Lévi, France's most distinguished orientalist, which took place suddenly on October 30, at the age of seventy-two years.

Sylvain Lévi was born in Paris on March 28, 1863. From an early age he applied himself to the study of oriental languages, especially those of China and Tibet, and in 1886 he was appointed a lecturer in the Ecole des Hautes Etudes. He was a special lecturer in Sanskrit in the Faculty of Letters of the University of Paris from 1889 until 1894, when he was appointed to a chair in the Collège de France. At the time of his death, he was president of the Société Asiatique and of the section of religious studies in the Ecole des Hautes Etudes. Among other honours he was an officer of the Légion d'Honneur and an Hon. Litt.D. of the University of Calcutta.

Lévi had travelled frequently and far in the East to further his researches, applying himself deeply to the study of epigraphy, manuscripts and art, notably in China, Tonkin, India and Nepal, spending three years in the last-named country. On several occasions he held temporary appointments in Asia, at one time being a tutor in Sir Rabindranath Tagore's school at Santiniketan at Bolpur, Bengal, and later in charge of the Franco-Japanese Institute at Tokyo.

Although Lévi's approach to oriental studies had been through linguistics, his outlook and interests were never bounded by the limitations of the philologist or the purely literary scholar. His wide knowledge of eastern iconography, his sympathetic understanding of Eastern art, and his profound study of Buddhism, gave him an insight into the strength as well as the weaknesses of Indian culture, tradition and character, such as have been possessed by few European scholars. It was this quality, perhaps, more than any other, that gave Lévi his position of authority and influence among British orientalists, to whom, indeed, he was perhaps more closely akin than to the members of the German school of orientalists of his day. He was continuously in close touch with the Royal Asiatic Society and the India Society; and it is said that it was largely owing to his advice and his evidence before the committee, of which Lord Reay was chairman, that the School of Oriental Studies of the University of London was founded.

Among Lévi's more important works, apart from a large number of valuable contributions to the journal of the Société Asiatique and other specialist publications, are a study of the Indian theatre (1900), monographs on Nepal (1905–8), "Buddhachariya", an epic life of the Buddha by Asbaghosha, a dictionary of Buddhism from Chinese and Japanese sources, and two books on India, which appeared in 1925.

WE regret to announce the following deaths:

Prof. Jakob Schetelig, professor of mineralogy and geology in the University of Oslo.

Dr. Eugene W. Shaw, chief geologist of the Iraq Petroleum Co., formerly of the U.S. Geological Survey, on October 7, aged fifty-four years.

News and Views

Exploitation of Science in Company Promotion

CONSIDERABLE interest has been aroused in financial circles by a circular letter issued by the Chancellor of the Exchequer prior to the General Election to the clearing banks, issuing houses, and the various stock exchanges, relative to securing scientific and technical advice as to the value of processes which form the subject matter of new company prospectuses. The interest, probably, would have found wider expression, but for the turmoil of the elections. The text of the letter itself is as follows:

"The Chancellor of the Exchequer has been giving some thought to the question whether he could aid in strengthening existing means for checking the flotation of companies designed to exploit processes based on a scientific foundation which is intrinsically dubious or even unsound.

"Mr. Chamberlain is, of course, aware that when new projects are brought to the notice of Banks, Issuing Houses and Brokers they scrutinise them with great care before associating themselves with them. Nor does he fail to recognise the many contacts which exist to-day between industry and science.

"On the other hand, it would, no doubt, be generally recognised that within recent times a number of prospectuses have been issued containing claims for the scientific value of particular methods or substances which would not have been endorsed by the best scientific authority.

"Mr. Chamberlain has ascertained that the three research organisations of the Government (the Department of Scientific and Industrial Research, the Medical Research Council, and the Agricultural Research Council) would be willing, if asked to do so in any particular case, to suggest the names of scientists of the highest standing who could be invited by Banks, Issuing Houses or Brokers to furnish them with reports on the scientific merits of the methods or substances for the development of which it might be proposed to make a public issue.

"Any request of the kind above mentioned can be addressed to the Secretaries of the three Government Research organisations named above."

Safeguarding Interests of Investors

THE motive underlying the Chancellor's circular letter is excellent, indicating, as it does, a sense of governmental responsibility for the safeguarding of the interests of the investing public. The method suggested is plausibly sound; but several aspects require to be considered. It is understood that if a request were made for advice to any of the three organisations mentioned, they would first consult with the particular learned institution whose field of activity was involved. Nevertheless, such a practice is calculated to occasion uneasiness to practising consultants in the fields of science and technology. The safeguard suggested by the Chancellor would not confer on an investor who had lost money the right to prosecute either of the Departments concerned; and altogether it is rather a heavy responsibility to be shouldered by any Government department if it is to be effective. Consultants have suffered from the depression of recent years, and it would not be in the public interest if regulations were to be made limiting the prospects of the consulting field in science and technology. Just recently the question of scientific and technical advice has been exercising those connected with the mining industry in South Africa; and a suggestion has been made that the Companies Acts should be so amended as to make it illegal for a mining company to be formed unless its board includes a scientific expert or technician of independent status. Provided that the experts so appointed are actually independent, there is a good deal to be said for such a suggestion; but it would probably prove necessary to make such experts personally and financially responsible for their advice.

Prof. Henry Balfour and the Pitt-Rivers Museum, Oxford

IN conferring the title of 'professor' on Dr. Henry Balfour, curator of the Pitt-Rivers Museum since 1891, the University of Oxford has elected to honour one of her sons whose lifelong devotion to an idea, pursued with characteristic self-effacement and sanity of outlook, has built up from its modest beginnings an institution of world-wide repute and of unique standing among ethnographical collections. In the Pitt-Rivers Museum and in his many writings on technology in cultural development, Prof. Balfour has applied and extended the principle of evolution in material culture formulated by General Pitt-Rivers, whose collections provided the nucleus of the Museum, in such a manner that it has become one of the most powerful instruments of research in the hands of the student of artistic and technical achievement, as well as of the movements and contacts of peoples in the history of civilisation in the broadest sense. Since the death of Sir Edward Tylor in 1917—indeed from the time he relinquished his office in 1909—the chair of anthropology in the University of Oxford, for purely domestic reasons, has been vacant. The organisation of separate studies in the subject, which has obtained in the interval, no doubt has not been without its advantages, academic and other. Though anthropologists may entertain some feeling of regret that this group of studies at Oxford is still without its professor, they will admit that this circumstance enhances the signal character of the honour now conferred on the technological studies associated with the Pitt-Rivers Museum and of the personal tribute to its curator.

Presentation of the Petrie Medal to the Abbé H. Breuil

IN the proceedings of Foundation Day of the University of London on November 21, over which the Chancellor, Major-General the Earl of Athlone,

presided, the premier honours were accorded to the Abbé H. Breuil, who was present to receive the Petrie Medal awarded him in recognition of his services to archæology. The study of the origin and growth of civilisation from its earliest beginnings down to historic times is fortunate at the present day in having in its service a number of brilliant exponents in practice and in theory of archæological methods of investigation, whose authority receives world-wide recognition. Among these, the Abbé Breuil is a commanding figure. For a generation he has stood in the front rank of French archæologists. His investigations in the caves and occupation sites of palæolithic man in France, Spain and North Africa have added a mass of facts to the sum total of our knowledge of the history of man's early development, while his personal examination of all the more important archæological sites, and the archæological and palæontological material derived from them, throughout the world has given breadth and vision to that innate aptitude for the analysis of evidence and the logical classification of scientific data, which has won acceptance of his verdict in all questions relating to prehistoric archæology as a final court of appeal. The ovation given the Abbé Breuil at the close of the more formal proceedings of the assembly on Foundation Day was no more than an endorsement of an award, which in the fullest sense of the term was deserved.

Rudolph Fittig (1835–1910)

THE centenary of the birth of Rudolph Fittig, who made important contributions to the development of organic chemistry, falls on December 6. His early scientific work was carried out at Göttingen where he was assistant to Wohler, and became *Privatdocent* in 1860 and professor in 1866. Whilst at Göttingen, Fittig was the late Sir William Ramsay's tutor (1871). From 1876 until his death, he was professor of organic chemistry at Strassburg. He is best remembered for his synthesis of the higher hydrocarbons, particularly the benzene homologues, by the action of sodium upon alkyl or aryl halides or on mixtures of both. It is not so generally realised that Fittig also studied the action of sodium on aldehydes and other series of organic compounds and carried out extensive researches on unsaturated acids. In the course of this work he prepared a number of sets of isomeric (active and inactive) acids and showed their relationships. He suggested a 'ketone' formula for benzoquinone in 1873 and this was afterwards adopted under the title of 'quinonoid structure' for this type of compound.

Johann Faulhaber (1580–1635)

AMONG the victims of the plague which ravaged Central Europe during the middle years of the Thirty Years' War was Johann Faulhaber. The exact date of his death, which occurred at Ulm in 1635, is unknown. Like Schickard (see NATURE of October 19, p. 636), Faulhaber was a mathematician of distinction. He dabbled in alchemy, announcing in 1621 that he would produce from one measure of gold two measures of the same metal of the finest quality. In spite of this unsubstantiated claim, he enjoyed a wide reputation as an able mathematician and as a constructor of ramparts and fortifications. He was visited in 1620 by Descartes, who was then serving in the French army in Germany.

A New Blue Pigment

THE introduction of a new insoluble blue pigment by Imperial Chemical Industries, Ltd., is of much more than passing interest. Monastral Fast Blue BS has none of the various drawbacks of the long-known Prussian blue and ultramarine or the more recently discovered blue lakes derived from coal tar colours, and will inevitably replace them in paints, distempers, varnishes, enamels, in textile printing and in the pigmentation of rubber, plastics and cements. As it is a very close approximation to a true 'minus red', the new pigment allows much brighter greens and purples to be obtained by admixture. The remarkable stability and inertness of the pigment are manifest in its exceptional fastness to light, heat, acid or alkali, and its complete insolubility in water, oil, spirit and nitrocellulose solvents. This new pigment belongs to a class of coloured substances to which the name 'phthalocyanine' was applied by Linstead, who first made clear their chemical nature (1934). The first phthalocyanine was obtained fortuitously as a by-product during the production of phthalimide at the Grangemouth Works of Scottish Dyes in 1928. It was a compound containing iron united with four molecules of phthalonitrile. Monastral Fast Blue BS is the corresponding copper derivative. Structurally, it is an aggregation of four *iso*indole units linked in a 16-membered ring of alternate carbon and nitrogen atoms around a central copper atom. The metal is held by two covalent and two co-ordinate bonds to four nitrogen atoms. The phthalocyanines are closely related to the porphyrins, which form the basis of some naturally-occurring colouring matters such as chlorophyll. Apart, therefore, from the value of the pigment in the arts, its chemical nature confers upon it a considerable scientific interest.

Darwiniana for Down House

THE British Association has recently received from Prof. Van Dyck a holograph letter of Charles Darwin's which must be one of the last from his pen, since it is dated April 2, 1882, only seventeen days before his death. The letter typifies the care and courtesy with which Darwin considered work sent to him by fellow-inquirers. He tells the young Dr. Van Dyck that "After much deliberation I have thought it best to send your very interesting paper to the Zoological Society in hope that it will be published in the Journal". He has preferred this journal to NATURE, which "has a wider circulation but is ephemeral". The journal, however, is "much addicted to more systematic work", so that if the paper be rejected by the Society it is to be offered to NATURE, as "I am very anxious that it should be published and perused". The Association has also

received from the Director of the Victoria and Albert Museum, with the generous consent of the Board of Education, a tall silk hat and a soft straw hat which were Darwin's: as a matter of history, the size is 7¼, possibly smaller than might have been supposed. Both the letter and the hats are now on exhibition at Down House.

Commemoration of Robert Hooke at Oxford

A REPRESENTATIVE Oxford gathering met in the Divinity School on November 20 to do honour to the memory of Robert Hooke of Christ Church, who was born three hundred years ago. Dr. R. T. Gunther, reader in the history of science, presided. The Warden of New College gave an address on the earliest 'Oxford Movement', that resulted in the formation of the Royal Society and, in particular, on the manifold activities in science and art of Hooke and Christopher Wren in London during the reign of Charles II. He pointed out why it was that the former, despite his many qualities, missed supreme greatness. Dr. Gunther spoke of Hooke's discoveries in mechanics, optics, biology and astronomy, and of his great inventive genius generally. Dr. Russell said what could be said of the work done in relating combustion and respiration to the gas afterwards named oxygen. Accounts were read of Hooke's activities in geology and other subjects. The Dean of Christ Church recalled in a witty speech some of the admirable qualities which Hooke showed as a man. He afterwards opened an exhibition devoted to Hooke's work, arranged by Dr. Gunther in one of the rooms of the Old Ashmolean Building. This contained early editions of the "Micrographia" including the beautiful original plates, books owned and annotated by Hooke, modern books about him, models of his microscope, of his mechanical inventions and of the apparatus he used in demonstrations. Particularly interesting was a photograph of the first foraminifer figured and described by Hooke in 1661. There was a nice collection of drawings and photographs of the buildings that Hooke had designed. Prof. F. Soddy had had prepared many models to illustrate different modern applications of Hooke's joint. He demonstrated their working to the visitors, and spoke of the applications of the joint made more than sixty years ago by Franz Reuleaux.

T. H. Huxley as Anthropologist

SIR GRAFTON ELLIOT-SMITH made an especially happy choice of subject for his Huxley Memorial Lecture to the Royal Anthropological Institute on November 26, when he spoke on "The Place of Thomas Henry Huxley in Anthropology"—a topic which, as he pointed out, has been neglected, curiously enough, in the many lectures delivered previously in memory of Huxley. Yet Huxley was not only mainly responsible for the amalgamation of the two rival societies concerned with anthropological studies, which led to the foundation of the Anthropological Institute in 1871, but he was also the real founder of the scientific study of man in Great Britain. By his insistence on the biological point of view in the study of man, he effectually disposed of the loose and facile argument on so-called evolutionary lines, which paraded in the 'sixties of the last century as scientific theory. In emphasising man's place in Nature, he provided the science of human biology with its chief instrument, the means of interpreting and applying to mankind the knowledge acquired by the investigation of man's nearest kindred and merging it in biology as a whole. In recalling the controversy, now almost forgotten, over the 'Hippocampus', in which Sir Richard Owen figured, Sir Grafton rightly stressed the importance of Huxley's identification and pioneer work on the calcarine region which made possible the definition of the characters that conferred its unique qualities on the human brain. Incidentally, he revealed that Huxley's work on this subject was the starting point of his own investigations of the brain and the comparative study of the development of its functions, especially in connexion with the acquisition of stereoscopic vision and its consequences for human evolution.

New Foreign Members and Correspondents of the Geological Society of London

AT the meeting of the Geological Society of London on November 20, Prof. C. P. Berkey and Prof. P. D. Quensel were elected foreign members, and Prof. F. Broili and Dr. E. P. de Oliveira foreign correspondents, of the Society. Prof. Charles P. Berkey, of Columbia University, is well known to geologists in Great Britain as the secretary of the Geological Society of America, a position he has held since 1922. His publications cover a wide field, but in recent years have been principally devoted to the geology of Mongolia, and have appeared as the reports of the Central Asiatic Expeditions of the American Museum of Natural History. Prof. Percy Quensel, of the University of Stockholm, has on several occasions lectured in Great Britain. His researches have been devoted principally to the elucidation of the problems of the petrology and structural features of the older rocks of Sweden; but he has also published papers on the geology and petrology of Patagonia. Prof. Ferdinand Broili, of the University of Munich, is noted for his studies on the fossil reptiles and Stegocephalians, and has also published papers on the Permian brachiopods and the Devonian trilobites. Dr. Euzebio Paulo de Oliveira is the director of the Serviço Geologico e Mineralogico do Brasil. His published works have been principally descriptive of the mineral resources of Brazil.

Air Transport Exhibition at the Science Museum

AN exhibition portraying the organisation and operation of the air services over Empire air-routes will be opened at the Science Museum, South Kensington, by the Secretary of State for Air on December 5, and will be on view to the public from December 6 until January 31. The exhibition, which is being organised and staged by Imperial Airways Ltd., is popular in character, both in scope and treatment, and will illustrate the development of air communications within the Empire by means of

models, charts, maps and photographs. It will include models of every type of air liner which has been owned by the Company since its inception, and sectional models of the new "Empire" flying-boat, the new Armstrong-Whitworth 4-engined land machine (A.W. 27) and the Short-Mayo "composite" marine aircraft, now under construction. The latter is of special interest as an entirely new project designed to meet the requirements of trans-Atlantic services. A part of the exhibition will be devoted to the design of air ports, and will include a large model of a modern combined land and air port, and dioramas of three famous Empire air ports. There will also be working models showing the part which wireless plays in the control of aircraft when flying in fog or above cloud. There will be sections devoted to the building of a flying-boat and a land machine and to aero engines. Operable models of a wind tunnel and a tank will enable the visitor to gain some idea of the part which these instruments play in the design of air liners. The exhibition should prove of considerable educational interest at the present time, and will serve to show the remarkable developments which have taken place in air transport during recent years; by way of comparison, the earlier historical development in aviation can be seen in the usual gallery of the National Aeronautical Collections in the Museum.

Alchemy and Music

THE audience for the Friday evening discourse delivered at the Royal Institution on November 22 had a double treat, for after listening to Prof. John Read's address entitled "A Musical Alchemist", some recently transcribed music by Count Michael Maier (1618) was sung by student members of the St. Andrews University Choir under the direction of Mr. F. H. Sawyer, lecturer in music in the University. Certain alchemical works published at or near Frankfort during the seventeenth century, largely under the name of Michael Maier, are rich in allegorical illustrations, which Prof. Read terms, for convenience, 'the Frankfort emblems'. The publishing firm of Lucas Jennis of Frankfort took a prominent part in issuing Maier's works. His emblems are often provided with a Latin epigram, together with a cryptic title and a discourse in the same language. "Atalanta Fugiens", or "Atalanta Fleeing", published by Maier at Oppenheim in 1618, contains fifty such epigrams, written in elegiac couplets and set to music by the versatile author. Maier's so-called 'fugues' are in reality rounds, or canons, for three voices. At the end of Prof. Read's discourse, Mr. F. H. Sawyer, who has made a close study of this interesting alchemical music, explained its construction and characteristics, after which examples were sung. It is to be presumed that these 'incantations' were intended to be sung at critical moments during the decoction of the Philosopher's Stone, such operations being directed also by prayer and astrological influences. To what extent Maier, or other alchemists, endeavoured to influence their laboratory operations by means of music is not clear. However, in view of the alchemical belief in the beneficent influence of music, it is likely that the processes of the 'Great Work' were sometimes performed to the accompaniment of musical chants or incantations.

Dangerous Reflexes of Car Drivers

"How Cars go out of Control: an Analysis of the Driver's Reflexes" is the title of a paper by Dr. Yandell Henderson, professor of applied physiology in Yale University, read before the National Academy of Sciences, Washington, on November 18. He attributes this situation to the 'self-righting' reaction which is instinctively and irresistibly excited by any sudden severe disturbance of equilibrium. The self-righting reaction is proverbial in the cat: no matter how the cat is dropped, it lands always on its feet. Into this neuro-muscular complex in man enters the 'extensor thrust' reflex of the lower limbs, owing to which a motor-car driver, often quite unawaredly, presses the accelerator pedal hard down, and continues to do, thus sending the car completely 'out of control'. Prof. Henderson realises that we cannot change the nature of so primitive a danger-response. His remedy consists in placing a pedal for the left foot "so low as scarcely to rise above the floor, but wide enough so that extension of the leg will always bring the foot to bear on it". The extensor thrust reflex involves both feet. The left pedal will be so connected that heavy pressure on it will either counteract the action of the right foot and so close the throttle, or will directly shut down the carburetter. From statistical studies, Prof. Henderson believes that at least ten per cent of fatal car accidents are attributable to the car being 'out of control' through the 'extensor thrust' of the driver's legs.

Rectifiers used on the London Underground Railways

WHEN an alternating current arc is established in a vacuum tube between a mercury and an iron or graphite electrode, the current only passes during half the time, namely, when the mercury pool is the negative electrode. The alternating current is thus converted into a pulsating direct current, the tube (rectifier) thus acting as a valve allowing the current to flow in one direction and not in the other. In a paper on the steel tank rectifiers operating on the underground railways of the London Passenger Transport Board, read by A. L. Lunn to the Institution of Electrical Engineers on November 7, a description of the rectifier substations is given and also much useful information of the working of these rectifiers for traction purposes. When the electric railways first started, they were supplied by three phase A.C. from the Lots Road generating station, the current being converted into direct current by means of rotary converters before reaching the trains. These machines were virtually A.C. motors on one side and D.C. dynamos on the other. For running machines, rotary converters are comparatively quiet, and there is little vibration; but in these respects the rectifier is much superior. The substation buildings for operating the traction system of the London

Underground are in very densely populated districts, and so the light weight and freedom from vibration of the rectifiers enable appreciable economies to be effected on the building costs. Mr. Lunn looks forward to the time when the continued development of the railway area may lead to the changing-over of a number of existing substations to new supply networks, probably involving a change of frequency. With the present system of rectifiers this would offer no difficulty.

Second-hand Electrical Plant

THE policy of the Central Electricity Board in closing down obsolescent electricity supply stations has had the effect of crowding the machinery and equipment market with plant at very low prices. In his presidential address to the Midland Centre of the Institution of Electrical Engineers, Colonel H. C. Fraser said that this plant is being bought by industrial users, and that this is detrimental to the supply industry. The user having very small capital charges is placed in a strong position to compete with the public supply. The recent sales of electrical plant and fittings from ocean liners, such as the *Mauretania* and the *Olympic*, have also decreased to a certain extent the capital charges of the purchasers. On the other hand, mill owners and others are very reluctant to dispose of existing moderately efficient plant at scrap values. The question is one of economics. When the user has capital at his disposal, he can estimate the cost of the renovation of plant and the increase in profits that will probably ensue; and if satisfied, he should not delay the change-over too long. We think that the gain to the community effected by scrapping plant at the proper economical time far more than counterbalances the loss to manufacturers due to the consequent diminished demand for machines and equipment.

Antarctic Discoveries

SOME of the more important discoveries made by Admiral R. E. Byrd's American Antarctic Expedition of 1934–35 are indicated in sketch maps accompanying an article by Admiral Byrd in the *National Geographic Magazine* of October. There seems now to be no probability of a sea-strait joining the Ross and Weddell Seas, a suggestion made some years ago on slender evidence. It appears that Marie Byrd Land, which lies south-east of King Edward Land, extends in a plateau of over a thousand feet, called the Rockefeller Plateau, to the base of the Queen Maud Range, which has been extended another two hundred miles eastward. At the south-eastern end of the Ross Sea a gulf extends into this plateau to about long. 140° W. Another discovery is that the Edsel Ford ranges which lie east of the Alexandra Mountains of King Edward Land extend east and west, and suggest possible extensions of the Andean foldings of Graham Land. A third striking discovery, made by sonic soundings, is that much of the Ross Ice Barrier is aground and not afloat. South of the Bay of Whales, Admiral Byrd has tentatively marked an area of the Barrier extending between lat. 78° 40′ S. and 80° 20′ S. and long. 160° W. and 164° W. as Roosevelt Island. This he believes to be underlaid by land. Several altitudes in this area are well above the general level of the Barrier.

Science and Social Needs

IN his Halley Stewart Trust Lecture delivered in the Memorial Hall, Farringdon Street, London, on November 21, Prof. Julian Huxley discussed "Science and Social Needs". The academic view of science is that it is "pure"—a disinterested explorer of the unknown, and thus an accumulator of organised knowledge. Opposed to this is the view that science is essentially practical, showering upon humanity gifts in the shape of inventions and technical improvements. A third view is that science, far from being beneficent, is actually an evil genius. Of course, the application of scientific methods in the mechanisation of industry may result in unemployment. But the blame does not lie with the scientific worker, but rather with the present economic system. Science is actually a tool, and is therefore ethically neutral. The tempo of scientific discovery may be too fast for modern society; but that is a matter for practical adjustment, not for moral condemnation. The true fact is that science embodies both the first and second views, in that it is both knowledge and control, pure and applied. Progress may flow either from theory to practice or vice versa.

SCIENCE is a function of society, influencing the social system and being influenced by it in return. To-day it is often frustrated—actual discoveries already made are not applied. In fact, science is prosecuted and applied much more from the angle of the producer and the State than from that of the consumer or the individual citizen. Research where an immediate profit can be discerned obtains far greater financial support than long-range research where the advantage is indirect. Prejudice too may often interfere with the use of scientific methods of analysis. This applies especially to social science, education, etc. Social forces could be scientifically analysed and controlled, and social machinery scientifically designed and planned in the same way as has been done for natural forces and industrial machinery. In order to prevent the present piecemeal or lop-sided development of science, we need a new discipline—the scientific study of science itself, in its capacity as a social function.

Journal of the Institution of Civil Engineers

WITH the opening of the 1935–36 session, there appears the new *Journal of the Institution of Civil Engineers*—an occasion which marks another stage in the development of the Institution's publications, and should increase the facilities for "the acquirements of knowledge in engineering", laid down by the founders as one of its objects. Portraits of the first president, Thomas Telford (1820–34), and of Mr. John D. Watson, who now occupies this office, appear in the first number, which opens with a foreword by Mr. Watson and an interesting account of the origin and progress of the Institution. Then follows the presidential address for the current

session, which dealt with the problems of water-supply, sewerage and sewage disposal during the last fifty years. Whilst maintaining continuity with previous publications, it is intended that the *Journal* shall enable the earlier publication of papers and the wide dissemination of the reports of the Research Committee and its sub-committees, one of the important activities of the Institution. Eight numbers of the *Journal* will appear each year, six in the session and two in recess. In the form in which the first number appears, the *Journal* is assured of a favourable reception from all who are interested in the work of the Institution.

THE present issue of the *Journal* contains details of the work of the Research Committee, four papers published by the Institution and a special lecture on "Surveying from Air Photographs" by Brevet-Major Martin Hotine, R.E. Among these, the most important contributions are Mr. E. H. Bateman's paper on "The Open Frame Girder" and J. P. R. N. Stroyer's on "Earth-Pressure on Flexible Walls". The former is an extended analysis, by the strain energy method, of uniform and non-uniform girders, and tables and diagrams are given to show the effect of variation in the stiffness-ratio, from which the effect of variation in the number of panels can be inferred. Mr. Stroyer's paper records the nature and results of an investigation by means of special apparatus on the pressures produced by several materials on wall panels flexing between supports, and sets out the several conclusions at which the author has arrived. Written communications on these papers have been invited by the Council.

Recent Acquisitions at the Natural History Museum

AMONG recent additions to the zoological collections at the British Museum (Natural History) are six skins of Malagasy mammals, including a rare insectivore (*Limnogale mergulus*) presented by Sir Frank Colyer. Acquisitions by the Department of Geology include a series of invertebrate fossils from the Permian of Durham, presented by Dr. C. T. Trechmann. These are arranged to show how the increasing salinity of the sea in which the animals lived led to progressive dwarfing and finally to the extinction of the forms. The Mineral Department has acquired by purchase a faceted cassiterite (tin-stone), weighing 13¼ carats (2·713 gm.), together with a crystal of similar material, from Uganda. Cassiterite, known since classical times as the important ore of tin, has seldom provided transparent pieces of sufficient size for cutting for ornamental purposes, so that this specimen is an interesting addition to the collection of faceted stones. The purchases include a carefully collected and labelled set of Swiss rocks, together with the corresponding thin sections, which form a valuable addition to the collection of rocks. Thanks to the courtesy of the Director of the Royal Museum of Natural History at Brussels, the Museum has received part of five rock specimens which, though collected by the *Challenger* Expedition, were described by A. F. Renard and retained at Brussels.

Everyday Science in Civil Service Examinations

WE directed attention in our last issue (p. 825) to the withdrawal of "Everyday Science" from the list of obligatory subjects in the examination for admission to the Administrative Group of Civil Services—a step which appears to us regrettable. The policy of the Civil Service Commissioners in determining the type of the questions set in the examinations in science subjects is also called in question in an article by Dr. Herbert Dingle in *Time and Tide* of November 16. In discussing the part played by examinations in causing the ineffectiveness of scientific training in public life, Dr. Dingle relates his experience in the preparation of questions in astronomy. This confirms us in our opinion that the place of science in these examinations is not all that it should be.

British Institute of Radiology: Annual Congress

THE ninth Annual Congress of the British Institute of Radiology (incorporated with the Röntgen Society) will be held on December 4–6, in the Central Hall, Westminster, S.W.1. The Congress will be opened on December 4 at 3 p.m by the Right Hon. Lord Nuffield. An exhibition of apparatus, organised by the British X-ray industry, will be held at the same time. On December 5, Dr. G. W. C. Kaye will deliver the eighteenth Silvanus Thompson Memorial Lecture entitled: "Forty Years of Radiology (1895–1935): a Review and Some Reminiscences". On the same day, several physical, technical and therapeutical papers will be read. On December 6, Dr. G. Harrison Orton will deliver the sixteenth Mackenzie Davidson Memorial Lecture entitled "Calcium Changes and their Importance in Diagnostic Radiology", and some papers on diagnostics will be read. Further information concerning the Congress can be obtained from the General Secretary, British Institute of Radiology, 82 Welbeck Street, W.1.

The Leonids

ATTENTION was first directed to this shower of meteors by Humboldt, who observed a great display at Cumana, Venezuela, on November 11, 1799. It was not, however, until the meteor 'storm' of 1833 that the shower was observed scientifically. The next return of the main swarm was observed in England in 1866 and in America in 1867. The period of about 33¼ years was now, by researches into records of past great 'storms', fully established. The next return, 1899, was eagerly awaited, but in the general excitement the work of Drs. Stoney and Downing was overlooked. They showed that planetary perturbations would probably deflect the richest portion of the stream so that it would escape encounter with the earth, and thus the recurrence of a great 'storm' was doubtful. The failure of the Leonids of 1899 has become historic, although good showers were seen in America in 1901 and in England in 1903. Observations have shown a steady increase of Leonid activity year by year in the few years up to 1931, giving hope of another 'storm' about 1933. The promise, however, was not fulfilled. Mr. A. King informs us that this year on November 15, about a day before

the probable maximum, the Leonids were again very scarce. It therefore seems unlikely that there was any extraordinary display at that epoch. British observers generally experienced cloudy skies at that time, so that a definite statement cannot be made until reports from more favoured localities come in. Dr. S. C. Blacktin, 20 Denton Avenue, Roundhay, Leeds 8, has sent a report of a meteor seen at Leeds at 5.30 p.m. on November 16. This could not have been a Leonid, since the radiant at that time was 13° below the north-north-west horizon.

Recent Shower of Meteors

A WIRELESS message from Mohd. A. R. Khan, of Begumpet, Deccan, India, presumably sent on November 22, reads as follows: "Splendid meteoric shower last night. Gamma Monocerotis radiant." Assuming the radiant to have been exactly at γ Monocerotis (R.A. 114·5°; δ − 9·4°), and taking the date as Greenwich midnight of November 21 (November 22, 0h. U.T.), Mr. A. King has computed the following parabolic orbit: i, 115·0°; π, 135·4°; Ω, 58·8°; q, 0·608. The recently published "Index to Southern Meteor Showers" by Mr. R. A. McIntosh, of Auckland, N.Z., gives two radiants at 114½°–9°, November 15–16. Possibly Mr. Khan's shower represents a continuation of this stream, but more cannot be said until definitive details come to hand.

Announcements

THE Symons Gold Medal for 1936 of the Royal Meteorological Society has been awarded to Prof. Wilhelm Schmidt, director of the Central Institution for Meteorology and Geodynamics, Vienna. The medal is awarded biennially for distinguished work in connexion with meteorological science and will be presented at the annual general meeting of the Society on January 15, 1936.

THE Thomas Young Oration of the Physical Society will be given by Prof. Charles Fabry of the Institut d'Optique, Paris, on December 6 at 5 p.m. at the Imperial College of Science and Technology, South Kensington, S.W.7. The title of the lecture will be "Vision in Optical Instruments".

THE Right Hon. Lord Rutherford will open the new Research Laboratory of the London Midland and Scottish Railway Company at Derby on Tuesday, December 10 at 1.50 p.m.

THE opening of the next annual meeting of the Institution of Naval Architects will fall on April 1, 1936. A joint summer meeting will be held in the United States on September 14–19, 1936, at the invitation of the American Society of Naval Architects and Marine Engineers. Other British and foreign institutions will take part.

THE tenth Triennial Congress of the International Society of Surgery, of which 1,200 surgeons from 42 different countries are members, will be held at Cairo on December 30–January 4, under the presidency of Dr. Jan Schoemaker of The Hague. Further information can be obtained from the general secretary, Dr. L. Mayer, 72 rue de la Loi, Brussels.

ON the occasion of the seventy-fifth anniversary of its foundation, the Dr. C. Schleussner Company of Frankfort-on-Main offers a prize of 2,000 gold marks for the best scientific work on röntgenology. The president of the German Röntgen Society, in conjunction with the Dr. C. Schleussner Company, will decide the award. Purely technical and statistical works as well as those already published are excluded from the competition.

THE sixth assembly of the Spanish League of Mental Hygiene will be held in Madrid on December 2–6, when the following subjects will be discussed: suicide in Spain in its psychological and social aspects, the organisation of psychiatric assistance in families, and the intervention of the psychiatrist in tribunals for minors. The fee of five pesetas should be sent to the treasurer, Dr. A. Garma Cisne, 10, Madrid, from whom further information can be obtained.

ERRATUM.—In the last line of the letter "Records of Fatalities from Falling Meteorites", by Mohd. A. R. Khan, in NATURE of October 12, p. 607, for "Kawagam" read "Kawagaon".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A principal of the Rochdale Municipal Technical School—The Secretary, Education Office, Townhead, Rochdale (Dec. 5).

The following appointments in the University of Cambridge: a University lecturer and a University demonstrator in biochemistry (Sir F. G. Hopkins, Dec. 7); two University demonstrators in chemistry (Dr. R. G. W. Norrish); University demonstrator in zoology (Prof. J. Stanley Gardiner, Dec. 31).

A principal of the North-Western Polytechnic, Prince of Wales Road, Kentish Town, London, N.W.5—The Clerk to the Governors (Dec. 12).

An assistant (Grade III) in metallurgy and a junior scientific officer in the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Dec. 13).

A lecturer in organic chemistry in the Birmingham Central Technical College—The Principal (Dec. 14).

A lecturer in chemistry in the University of Capetown—The Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, London (Dec. 31).

A professor of chemistry in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (Jan. 6).

A lecturer (woman) in biology in the Darlington Training College—The Principal.

A lecturer in electrical engineering in the Burmah Oil Company's College of Mining and Engineering, University of Rangoon—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 874.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Influence of Certain Polycyclic Hydrocarbons on the Growth of the Jensen Rat Sarcoma

As the outcome of considerations which will be discussed more fully in a forthcoming paper, experiments were performed to test the effect of certain polycyclic hydrocarbons on the growth-rate of the Jensen rat sarcoma. The present note is the first report on this investigation, and records the results obtained in experiments involving a total of 350 animals.

On account of the insolubility of these hydrocarbons in aqueous media, and in order to ensure a certain degree of absorption into the general circulation, the compounds to be tested were administered in the form of an aqueous colloidal suspension in 0·5 per cent gelatin, prepared by the method described by Boyland[1]. In most experiments the animals received daily intra-peritoneal injections of such preparations.

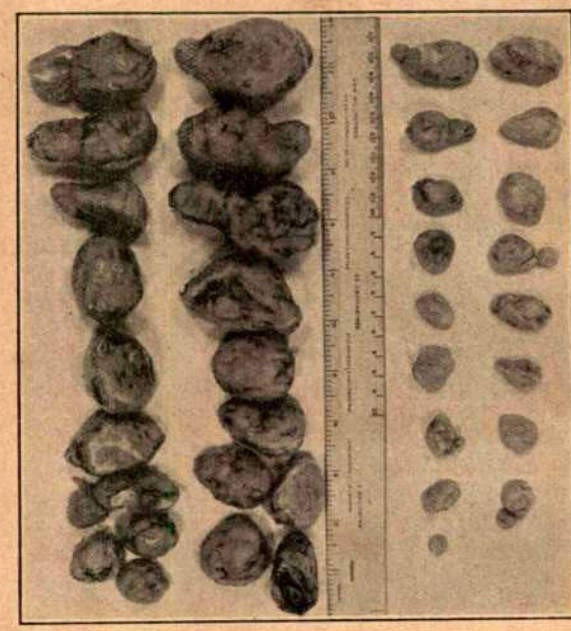
The effects of this treatment were studied by observing the behaviour of the Jensen transplantable sarcoma growing subcutaneously in the right flank, either by making daily measurements or by weighing the tumours after removal at the termination of each experiment. The significance to be attached to any given test was assessed by comparing such data with the corresponding results from simultaneous controls. The latter received similar daily injections of a gelatin solution treated exactly as in the preparation of colloid except for the addition of hydrocarbon.

In most experiments, treatment was started on the day of implantation and continued for 14–20 days, when the tumours were removed, weighed and photographed. Each test animal received a total dosage, varying in different experiments, of 15–40 mgm. of hydrocarbon. Although in certain experiments the treated animals appeared to grow less rapidly as compared with the controls, their general condition and activity remained good.

The data were studied by the application of Fisher's t method, and the accompanying table summarises the results in eleven experiments with six hydrocarbons. As a representative example, Fig. 1 shows the effect as seen in Experiment 7.

Expt.	Duration (days)	Hydrocarbon	Mean tumour weights (gm.)		n	t	P
			Controls	Treated			
1	21	1 : 2 : 5 : 6-dibenzanthracene	33·2	6·9	14	9·39	< 0·01
2	19	,, ,,	17·1	4·7	20	4·36	,,
3	18	,, ,,	12·0	1·7	11	5·30	,,
4	14	,, ,,	5·8	1·7	17	4·21	,,
5	10	1 : 2-benzpyrene	2·5	0·7	31	4·68	,,
6	15	,, ,,	7·6	2·0	9	11·03	,,
7	18	5 : 6-*cyclo*penteno-1 : 2-benzanthracene	18·3	3·5	24	5·54	,,
8	18	1 : 2-benzanthracene	18·3	7·5	28	3·58	,,
9	18	Anthracene	19·7	22·8	12	0·67	*c.* 0·5
10	15	Phenanthrene	10·6	12·0	20	0·64	0·6–0·5
11	15	,, ,,	11·2	11·5	15	0·13	0·9

It is clear that these experiments are sharply divided into two groups, and this has been indicated in the table. Under the conditions described, there can be no doubt that colloidal preparations of 1 : 2 : 5 : 6-dibenzanthracene, 1 : 2-benzpyrene, 5 : 6-*cyclo*penteno-1 : 2-benzanthracene and 1 : 2-benzanthracene produced a highly significant inhibition of the growth of the implanted tumour. On the other hand, anthracene and phenanthrene proved completely devoid of inhibitory power under the same conditions.



(*a*) (*b*) (*c*) (*d*)

FIG. 1. *Experiment* 7: Appearance of tumours after removal on eighteenth day following implantation:
(*a*) from animals injected daily with 2·5 c.c. control material.
(*b*) from control animals uninjected.
(*c*) and (*d*) from experimental series (animals injected daily with 2·5 c.c. of a 0·03 per cent colloidal preparation of 5 : 6-*cyclo*penteno-1 : 2-benzanthracene).

From other evidence (which will be reserved for future discussion), it seems possible that carcinogenic substances and agencies may act primarily by producing a certain type of inhibition in the activity of the normal cell, and it is of interest that the inhibitory effects described above are most obvious in the case of the substances 1 : 2 : 5 : 6-dibenzanthracene, 1 : 2-benzpyrene and

5 : 6-*cyclo*penteno-1 : 2-benzanthracene—the marked carcinogenic properties of which have been proved by the work of Kennaway and Cook and their collaborators[2, 3, 4]—less so in the case of 1 : 2-benzanthracene, the carcinogenic activity of which is feeble[4] and completely absent in the non-carcinogenic substances anthracene and phenanthrene.

Much further work is obviously required in order to test this hypothesis, but should a definite correlation be found to exist between carcinogenicity and inhibitory power, it is perhaps legitimate to point out that the paradox is only apparent, and is matched by the double action of X-radiation in inducing tumour formation or in controlling the growth of a tumour already established.

These experiments are accordingly being extended to determine (*a*) the effect on other tumours; (*b*) the action of other hydrocarbons both carcinogenic and non-carcinogenic; and (*c*) the effect of higher dosage. Full details of this and related work will be published in due course.

This investigation is being carried out with the aid of an expenses grant from the British Empire Cancer Campaign, and certain additional costs were defrayed by a payment from the Roughhead Fund of the University of Edinburgh.

My best thanks are due to Prof. J. W. Cook for his generosity in providing me with various pure samples (prepared in the Research Institute of the Cancer Hospital) of 5 : 6-*cyclo*penteno-1 : 2-benzanthracene and 1 : 2-benzanthracene, and for a supply of 1 : 2 : 5 : 6-dibenzanthracene. Without these the present work would have been impossible.

The tumour employed was originally obtained through the kindness of Dr. J. A. Murray. The majority of the animals were hooded rats of the Lister Institute strain, since previous experience had shown these to be particularly suitable for use with the Jensen sarcoma. For facilities in obtaining supplies of these animals I am indebted to Prof. J. C. G. Ledingham and Miss H. H. Smith. I wish also to express my gratitude to Col. A. G. McKendrick for his kind help in the statistical examination of results.

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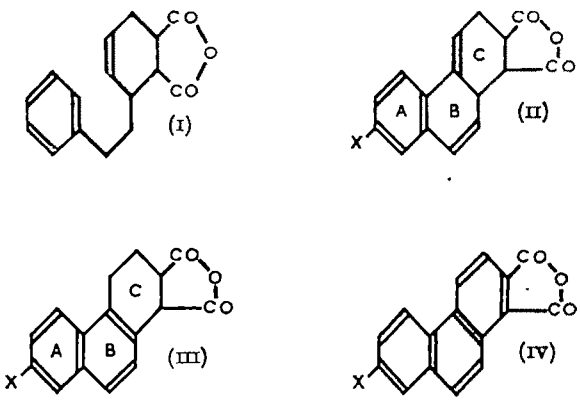
Nov. 10.

[1] E. Boyland, *Lancet*, ii, 1108; 1932.
[2] J. W. Cook, I. Hieger, E. L. Kennaway and W. V. Mayneord, *Proc. Roy. Soc.*, B, 111, 455; 1932.
[3] J. W. Cook, *Proc. Roy. Soc.*, B, 111, 485; 1932.
[4] G. Barry, J. W. Cook, G. A. D. Haslewood, C. L. Hewett, I. Hieger and E. L. Kennaway, *Proc. Roy. Soc*, B, 117, 318; 1935.

Synthesis in the Sex Hormone Group

INVESTIGATIONS into the application of the 'diene-synthesis' to the above problem have been continued in this laboratory since the completion of experiments described in an earlier communication[1]. The latter was chiefly concerned with the synthesis of 3-β-phenylethyltetrahydrophthalic anhydride (I), which, however, could not be cyclised to an octahydrophenanthrene derivative related to oxidative degradation products obtained from œstriol monomethyl ether by Doisy and his co-workers[2].

An obvious alternative route, which would obviate necessity for cyclisation, lay in employment, in the Diels-Alder reaction, of suitable naphthalene and hydronaphthalene derivatives containing an α-vinyl group. This has been carried out in a remarkably simple manner. 1-Vinyl-3 : 4-dihydronaphthalene could not be obtained through the Reformatsky reaction between α-tetralone and ethyl bromoacetate, a result by no means unexpected. But 1-vinylnaphthalene readily combines with maleic anhydride at ordinary temperature, affording the hydrophenanthrene-1 : 2-dicarboxylic anhydride (II or III; X = H) m.p. 186°–189° (decomp.) (Found: C 75·9, H 5·1 per cent. $C_{16}H_{12}O_3$ requires C 76·15, H 4·8 per cent), which is dehydrogenated by platinum black at 300° to phenanthrene-1 : 2-dicarboxylic anhydride (IV; X = H) (m.p. 310° corr.), recently described by Fieser and Herschberg[3].



[X = H or OCH_3]

After the completion of these experiments, there appeared a communication by Robinson and Walker[4], who had attempted to effect this type of synthesis. They were likewise unable to prepare 1-vinyl-3 : 4-dihydronaphthalene from α-tetralone, but stated that "no addition occurred" between 1-vinylnaphthalene and maleic anhydride.

In addition, dehydration of 6-methoxynaphthylethyl alcohol yields 1-vinyl-6-methoxynaphthalene, m.p. 41°–42°, which forms an orange-red picrate m.p. 114·5° (Found: C 54·7, H 3·7 per cent. $C_{19}H_{15}O_8N_3$ requires C 55·2, H 3·7 per cent) and combines with maleic anhydride, forming the methoxy-anhydride (II or III; X = OMe) m.p. 171°–175° (decomp.) (Found: C 72·2, H 5·2 per cent. $C_{17}H_{14}O_4$ requires C 72·3, H 5·0 per cent). The latter is dehydrogenated by platinum black at 280°–300° to 7-methoxyphenanthrene-1 : 2-dicarboxylic anhydride (IV: X = OMe) m.p. 253° (260° corr.) which is identical with a specimen obtained by a synthesis to be described elsewhere in a communication to be made jointly with Prof. J. W. Cook and Dr. C. L. Hewett. (Found: C 73·2, H 3·7 per cent. $C_{17}H_{10}O_4$ requires C 73·35, H 3·6 per cent).

Formula (II) represents the structure of the primary addition products from vinylnaphthalenes and maleic anhydride, and, in agreement with this formulation, the two compounds isolated (X = H and OMe) rapidly reduce cold alkaline permanganate. However, isomerisation to the naphthalene structure (III) by migration of an ethylenic linking from ring *C* to ring *B*, is not excluded. Indeed, if (II) is correct, the possibility of effecting both isomerisation to the

equilenin type (III) and reduction to the œstrone type (one aromatic ring) is envisaged.

These experiments are being extended in several directions, and will be described in detail elsewhere.

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Nov. 15.

[1] Cohen, *J. Chem. Soc.*, 429; 1935.
[2] Doisy *et al.*, *J. Biol. Chem.*, 101, 753; 1933.
[3] Fieser and Herschberg, *J. Amer. Chem. Soc.*, 57, 1508, 1853; 1935.
[4] Robinson and Walker, *J. Chem. Soc.*, 1530; 1935.

Excitation of Nuclei by Neutrons

THOUGH many investigations have been made both of fast neutrons and those of thermal energy, much less is known about neutrons of medium velocity. The experiments described below have been devised to investigate such neutrons.

Wertenstein found that artificial radioactivity induced in various substances by neutrons is influenced by layers of gold or lead interposed between the neutron source and the test-piece. The activity was increased if the test-piece consisted of silver or iodine whereas it was decreased if silicon or aluminium were used. It is now known that silicon and aluminium can be activated by fast neutrons only, whereas silver and iodine are more sensitive to slow neutrons. This agrees with Wertenstein's interpretation of the increased activity as being due to a slowing down by the absorber of the fast neutrons from the source. The energy lost by the neutrons is taken up by gold or lead nuclei in the form of excitation energy, and is presumably re-emitted as gamma radiation.

Now neither gold nor lead is strongly activated by neutrons. We thought it interesting to extend Wertenstein's measurements[1] to silver since this is a substance which can be strongly activated. For this purpose we prepared a silver cylinder with walls 15 mm. thick and measured the activation produced in different test-pieces by a Rn–Be source with and without the silver cylinder surrounding the source. Table 1 shows the observed change in the activation as a fraction of that obtained without the silver cylinder.

Test-piece	Increase of activation
Silicon	-23 ± 4 per cent
Aluminium	-19 ± 3 ,,
Silver	$+40 \pm 5$,,
Iodine	$+19 \pm 1{\cdot}7$,,
Rhodium	$0 \pm 2{\cdot}5$,,

From these results, the following conclusions can be drawn:

(1) The effect observed by Wertenstein is not restricted to the substances investigated by him.

(2) The decrease of activation of aluminium and silicon gives directly the cross section for the total absorption of fast neutrons by slowing down and possibly by capture. This cross section comes to 3×10^{-24} cm.^{2}.

(3) Collisions of neutrons with silver nuclei can lead either to an excitation of the nucleus without capture of the neutron, or to capture resulting in the formation of a radioactive element. This conclusion depends on the fact that both the existing isotopes of silver can be activated by capture and so no isotope is left that possibly could only be excited, but not activated.

(4) The activity induced in silver and rhodium is very differently affected by the absorber although these substances show almost the same increase when the neutrons are slowed down by paraffin. This proves that the neutrons slowed down by silver have different energies from those slowed down by paraffin. It further shows that the variation of the activation cross section with neutron energy is markedly different for different elements, at least in the energy range of the neutrons slowed down by silver.

Additional measurements gave the result that the increase of the activation of a silver test-piece is approximately proportional to the thickness of the retarding silver layer between 1 mm. and 15 mm. This result confirms Wertenstein's view that the slowing down of a fast neutron is effected by a single collision. It also shows that no appreciable part of the activity induced by neutrons in a thin silver test-piece is due to neutrons slowed down in the test-piece itself.

We have also studied the influence of a 3 mm. cadmium absorber interposed between the source and the test-piece. No decrease in activity was produced by the cadmium either with or without the silver cylinder surrounding the source. Provided cadmium does not retard neutrons to an extent comparable with silver, it follows from the margin of error in these measurements, that for the neutrons responsible for the activation by a bare source the cross section for absorption in cadmium is smaller than 10^{-23} sq. cm. In the case of the neutrons slowed down by silver the experimental error is larger; the lower limit for the cross section comes therefore to about 2×10^{-23} cm.^{2}.

According to Bethe's[2] theory of the variation of capture cross section with velocity, these limits indicate that the energies of both types of neutrons are of the order of 1,000 volts or higher.

To check directly the assumption that the neutrons are really slowed down by the silver we made the following experiments: A silver test-piece was placed at such a distance from the source that no measurable activity was produced. Then it was backed by a paraffin block in such a way that there was no paraffin between the source and the test-piece. With this arrangement the measured activity was enhanced by 25 per cent when the source was covered with the silver cylinder. Thus the elimination of primary neutrons in the silver block is more than compensated by the increased efficiency of those slowed down in the silver. This is to be expected as slower neutrons reach thermal velocity more quickly in paraffin since they need fewer collisions. As, on the other hand, slow neutrons are absorbed by paraffin, one should expect the effect to decrease if paraffin was interposed between the retarding cylinder and the test-piece. This was verified: When, in addition to the paraffin block behind the source, a block of paraffin 11 cm. thick was put in front of the test-piece the increase produced by the silver cylinder was only ten per cent.

Our thanks are due to Mr. Alton, of the Radium Institute, for supplying the radium emanation and for filling the sources.

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Nov. 10.

[1] NATURE, 134, 970, Dec. 22, 1934.
[2] *Phys. Rev.*, 47, 747; 1935.

Radioactivity of Ferro-Manganese Formations in Seas and Lakes of the U.S.S.R.

THE radioactivity of bottom sediments has been but little investigated. Data published by Joly, Pettersson, Piggot and Iimori refer to determinations of radium, contained mainly in oceanic deep-water sediments in red clays, radiolarian, globigerina oozes, blue muds and manganese concretions. The determinations have shown the manganese concretions to be richest as regards content of radium (up to 10^{-8} per cent); red clays and radiolarian ooze also possess a rather high content of radium. Other types of sediments are less rich in radium.

There are but very few determinations of radium in terrigenous sediments. The radioactivity of the bottom sediments of the U.S.S.R. is entirely unknown. I have therefore commenced a systematic investigation of these sediments. As a preliminary to the study of the radioactivity of the bottom sediments of each sea and lake separately, it seemed expedient to determine the radioactivity of a small number of the most characteristic types of bottom sediments from different seas and lakes. As the largest content of radium might be expected in deposits rich in iron and manganese, the ferro-manganese bottom deposits of different seas and lakes of the U.S.S.R. and two deep water concretions from the Pacific were used for the first investigations.

Besides radium, determinations have been made also of thorium X, the production of emanation and intensity of α-radiation. The results of radium determinations may be seen in the accompanying table.

Table 1.

No. of station	Depth in metres	Name of sea or lake	Radium content (per cent × 10^{-10})
1	512	Kara Sea	5·5
X	234	Barents Sea	1·8
425	181	White Sea	5·4
13	42	Lake Onega	9·2
3	10–12	Lake Konch	8·3
23	26	Bay of Finland	15·4
—	—	Black Sea	31·8
36	20	Caspian Sea	1·2
8,706	98	Lake Baikal	19·5
13	4,919	Pacific Ocean	146·6
285	4,343	Pacific Ocean	47·6

A more detailed table containing the co-ordinates and other data, as well as the characteristics of the samples, will be given in a special paper.

The results obtained make it possible to draw the following conclusions.

All the ferro-manganese formations of the seas and lakes of the U.S.S.R. investigated are to some degree radioactive.

Their radium content varies within wide limits—from $1·2 \times 10^{-10}$ per cent (Caspian Sea) to $31·8 \times 10^{-10}$ per cent (Black Sea); the mean for nine samples was $10·9 \times 10^{-10}$ per cent. In comparison with the oceanic deep-water concretions ($47·6 - 146·6 \times 10^{-10}$ per cent) the radium content in these ferro-manganese formations is considerably lower.

The determinations of the thorium X have shown that its content is small—less than 1×10^{-3} per cent Th X equiv. Th. The relation of radium to thorium shows that in the ferro-manganese formations, in comparison to the rocks, there is a manifest lack of elements of the thorium group. This fact indicates the want of the thorium in the concretions, and the partial, or entire disintegration of the short-lived isotope of radium—the mesothorium I.

The observations made show small concretions to be more radioactive than large ones or crusts, and also the surface layer to be more active than the central part of the concretion.

The different contents of radium and mesothorium I – thorium X in separate layers of the concretions, and the different correlations of separate elements, enable an approach to be made to the solution of the problem of the rate of formation of the ferro-manganese concretions by radioactive methods. A thorough radiological investigation of several concretions is being made for this purpose.

The radioactive elements in the bottom deposits may be divided into two groups: elements contained in the fragmentary material forming deposits, and elements derived from the water, as the result of various chemical and biochemical processes. In the ferro-manganese concretions and muds rich in iron the chief mass—perhaps even the entire one—of the radioactive elements may be ascribed to the second group. In this case we have encroachment and concentration of radium and its isotopes by deposition of colloidal forms of iron from the water. In proportion to the disintegration of the short-lived isotopes of radium, and also of the radium itself, the radioactivity of the concretions must, in the course of time, decrease.

Determinations are now being made of some few score concretions and bottom soils of the Kara Sea, as well as of a series of bottom samples from other seas and lakes of the U.S.S.R.

The results of the investigations will be given for each sea separately.

In conclusion, I wish to express my gratitude to A. D. Archangealsky (member of the Academy), Prof. A. L. Bening, Prof. K. M. Derugin, Prof. M. V. Klenova, Prof. J. M. Shokalsky and G. F. Ul, for their courtesy in putting at my disposal the samples, and furnishing me with the necessary data.

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A Simple Relay for Spark Counters of the Greinacher Type

H. GREINACHER[1] has described a valuable method for counting α- and β-particles by means of a spark-gap. A water-jet that is turned by the electrostatic forces between it and a pointed electrode allows an objective registration by opening and closing an electric contact. R. D. Summers[2] has pointed out that this arrangement can be used also as a relay.

I have found that it is possible to avoid the disadvantages connected with the use of a water-jet by constructing a mechanical relay. The electrostatic forces between a piece of spring steel and a copper sheet covered with a thin layer of mica are strong enough to attract the spring; this shuts the contact of a telephone counter circuit. The relay shunts the spark-gap. At the moment of ionisation of the air in the gap by a particle, a discharge occurs and the potential between the two electrodes of the gap breaks down. Therefore the relay is released for a moment and opens the circuit of the counter, which registers in this manner the presence of a particle.

The advantages of this mechanical relay are that it works without an auxiliary substance (water) and

it can be depended on for counts extending over a long period.

A detailed discussion will be published elsewhere (*Z. tech. Phys.*). The relay will be manufactured by E. Leybold, Köln a/Rh. I was enabled to construct the apparatus by a grant of the Deutsche Forschungsgemeinschaft.

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[1] H. Greinacher, *Helv. Phys. Acta*, 7, 360 and 514; 1934. 8, 89 and 265; 1935. *Z. tech. Phys.*, 16, 165; 1935.
[2] R. D. Summers, *Rev. Sci. Inst.*, 6, 39; 1935.

Effect of Light on Diamagnetic Susceptibilities

THE effect of light on paramagnetic susceptibilities of the ions of the iron group has already been reported by Bose and Raha[1]. They have shown how the l-component of the magnetic moment, which is more or less quenched in these ions, is partially freed on exposure to light. We have since performed the corresponding experiment for some diamagnetics in a Curie-Chéneveau balance with a fine phosphor-bronze suspension.

The halogens in their $^1\Sigma_g$ states are all known to be diamagnetic. Experiments with halogen vapours (chlorine, bromine and iodine) indicate that on exposure to light from which the infra-red portion was cut out, the susceptibilities increase in all cases. The exaltation of diamagnetism is evanescent at the red end, and remains very small until the violet end is reached. It is too early to offer a definite explanation, as the halogen molecule by absorbing light of wave-length shorter than the convergence limit (4785 A., 5107 A., 4995 A. for chlorine, bromine, iodine respectively) is adiabatically dissociated into two atoms ($^2P_{3/2}$ and $^2P_{1/2}$), both of which ought to be paramagnetic. This should result in a decrease, rather than an increase, of the average diamagnetic susceptibility of the vapour as a whole. But we may tentatively assume that the stationary concentration of atomic halogen is extremely small, and as such its effect is more than offset by the excited molecules to which the exaltation is due. The last we suggest in view of the fact that the effect, although small, is detectable even in the banded region.

The phenomenon is of the nature of a temporary shift of equilibrium only, as we could reproduce the dark deflection almost immediately the light was off. A side experiment with an air tube gave identical deflections both in the dark and in light.

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[1] Bose and Raha, *Phil. Mag.*, July 1935.

Archæology in South and East Africa

SOUTH AFRICANS interested in archæology are following the work in East Africa with keen interest in the hope that it may throw light on our problems, and that discoveries there may be interpreted with a due regard to our results. Mr. T. B. O'Brien's[1] views are therefore important to us.

He correlates (by implication, in time) the large-core phase of the Stellenbosch culture with the East African Early Acheulean, since the latter "marks the beginning of a large-core technique", and, further on, says that "Evidence is available in Uganda which suggests the presence here of a large-flake culture, separate from, but contemporary with the Chellean".

If Mr. O'Brien is correct in his correlation and van Riet Lowe[2] is correct in his classification of the Stellenbosch culture, according to which the Lower Stellenbosch uses "core and flake in almost equal proportions", then we must conclude that human history commenced at a very much later date in South than in East Africa.

Mr. O'Brien's correlation is, however, based purely on typology, deductions from which are vitiated by the inclusion of very serious assumptions in the line of reasoning, and Prof. Lowe's classification dates from a time when stratification of layers bearing various phases of the Stellenbosch culture, so far as natural deposits are concerned, were not known. Such a site is now known[3] and the successive, stratified phases are:

(1) Small Clacton flakes. (2) Very large Clacton flakes made into very rough *coups-de-poing* and cleavers. (3) Smaller Clacton flakes used for making the *coups-de-poing* described by Mr. Goodwin[4] from this area. A phase, apparently intermediate between (2) and (3), was found in a raised beach (about 20 feet) a few miles away; and on the surface of eroded sites there was also: (4) Still smaller Clacton flakes and small, beautifully made *coups-de-poing* of the Fauresmith type. (5) A very numerous association of still smaller flakes, not reddened like those of phases (3) and (4) but with surfaces such as could have been formed by the action of wind-blown sand. No *coups-de-poing* could be found among these and typical levallois cores are very common. The use of cores is very rare in phase II, but the core technique is used to an increasing extent in phases III and IV.

We have thus at Mossel Bay an evolutionary series demanding as large a slice of time as can be demanded for the evolution of any similar series in any other part of the world.

When I mentioned, in a previous letter[5], a Late Stellenbosch layer five or six feet above human remains in a shelter at Plettenberg Bay, I referred to a phase apparently intermediate between phases III and IV. I should perhaps have been more explicit than, for the sake of brevity, I was.

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Oct. 20.

[1] NATURE, 136, 475, Sept. 21, 1935.
[2] *S.A. J. Sci.*, 29, Oct. 1932.
[3] *Roy. Soc. S.A.*, 22, Pt. 3; 1934.
[4] *Annals S.A. Mus.*, 27, and *Roy. Soc. S.A.*, 16, Pt. 1.
[5] NATURE, 135, 620, April 20, 1935.

Inhibitory Effect of Phloridzin on an Enzymic Dismutation

RECENTLY it has been shown that phloridzin exerts an inhibitory effect on phosphorylations and dephosphorylations[1]. The action on enzymes other than diastase has not yet been investigated. On diastase no poisonous action of phloridzin was demonstrable[1,2]; however, phloridzin is not a specific inhibitor of phosphorylation and dephosphorylation. As the present communication shows, the dismutative conversion of triosephosphoric acid into phosphoglyceric acid and glycerophosphoric acid is also prevented or markedly inhibited by phloridzin in concentrations of about $N/100$.

Extract of rabbit muscles was used for the investigation. To the muscle extract, buffered at a pH of about 7·5, sodium fluoride phloridzin and finally the substrate hexosediphosphate were added. In the samples the decrease of P-compounds labile to acid hydrolysis and the increase of P-compounds resistant to acid hydrolysis were determined. Further, the hydrolysis of P-compounds in alkali at room temperature before and after oxidation with iodine was determined in order to estimate the accumulation of dihydroxyacetonphosphate and glyceraldehydphosphate[3,4]. In order to study the action of phloridzin on the formation of the last two substances, it is necessary to dilute the extract more than 100 times[3].

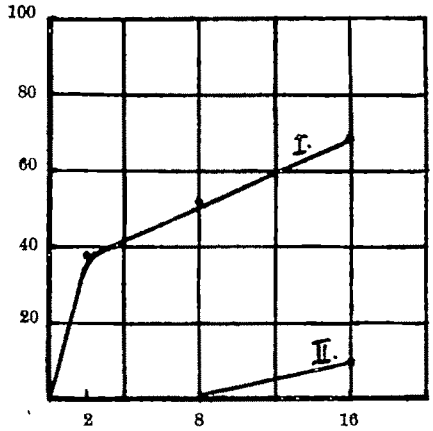

FIG. 1. Relation of percentage conversion into acid-resistant P-compounds (ordinates) to time in minutes (abscissæ). I: without phloridzin, II: with $N/100$ phloridzin.

The velocity of the conversion of hexosediphosphate into dihydroxyacetonphosphate and of this into glyceraldehydphosphate is not affected by phloridzin in concentrations of about $N/100$. On the other hand, the dismutative conversion of triosephosphate into phosphoglyceric acid and glycerophosphoric acid is inhibited 70–100 per cent by phloridzin in the same concentrations. In the same extract with starch as substrate, the well-known inhibition of the phosphorylation was observed. At the phloridzin concentration mentioned above, this inhibition was of the same order as the inhibition of the dismutation.

Further experiments must determine whether the inhibition of oxidation-reduction is an essential action of phloridzin.

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[1] Lundsgaard, *Biochem. Z.*, **264**, 209; 1933.
[2] Barth, *Biochem. Z.*, **270**, 63; 1934.
[3] Meyerhof and Lohmann, *Biochem. Z.*, **271**, 89; 1934.
[4] Meyerhof and Kiessling, *Biochem. Z.*, **279**, 40; 1935.

A Toxic Emanation from Rubber

APPARATUS of several types for measuring and controlling the humidity of the air in entomological experiments was recently described by us[1]. We mentioned a convenient type of glass jar, which is now in rather common use among entomologists and botanists, for studying the effects of climatic factors on insects or plants. It is a commercial glass storage jar with a screw-on metal cap. The joint between the glass and metal is sealed by a thick rubber washer. The humidity inside the jar is controlled by means of a layer of a suitable solution (of potash, acid, etc.) and the insects are placed in the jar in a celluloid and gauze container.

Since describing this apparatus, and after using it frequently, one of us has discovered a potential source of error. If new rubber washers are used to seal the jars, they may, under certain conditions only, give out a toxic substance. This poisonous emanation is much more powerful when the humidity in the jar is high than when it is low. Thus sometimes moist air may appear to be more unfavourable to an insect than dry, when the difference is actually due to a fault of the apparatus. Certain conclusions obtained using this type of apparatus, for example with regard to the unfavourable effects of high humidities on tsetse fly[2], must therefore be accepted with caution.

After exposure to air for four months, the rubber washers which we have been using completely lose their toxic properties, and it is safe to use them even in saturated air. Different samples of rubber vary considerably, and any apparatus for investigating effects of humidity which contains rubber joints should be carefully tested.

K. MELLANBY.
P. A. BUXTON.

[1] Buxton and Mellanby, *Bull. Ent. Res.*, **25**, 171; 1934.
[2] Buxton and Lewis, *Phil. Trans. Roy. Soc.*, B, **224**, 175; 1934.

Cytological Significance of the Nature of Sexual Fusion in Hymenomycetes

THE late Hans Kniep from 1915 onwards and Mlle. Bensaude in 1918 described the union of two mycelia of + and − strains as a necessary preliminary to the formation of the sporophore in heterothallic species of Hymenomycetes. In such cases, plasmogamy is usually separated from karyogamy in the basidium by several successive divisions of conjugate nuclei through clamp connexions. This is held as indicating a "degeneration of the sexual process", and as the principal point of distinction from the type of sexual fusion known in green plants, where there is *simultaneous* fusion of protoplasm and nuclei of two conjugating gametes. But a closer reflection would lessen this difference.

No doubt in the higher plants we have fusion of the two nuclei with the formation of the zygote and the initiation of the diplophase, but not the fusion of two sets of chromosomes (male and female), which simply lie together in the fusion nucleus; the actual fusion of chromosomes is delayed there by almost the same long steps until the prophase of the reduction division or meiosis in connexion with microsporogenesis or megasporogenesis. In the Hymenomycetes, on the other hand, the fusion of the two nuclei in the basidium is followed almost at once by the fusion of their chromosomes in connexion with meiosis. Thus, the only difference is that in the Hymenomycetes the two conjugate nuclei from two different strains (plus and minus) are not in actual contact with each other in the form of one fusion-nucleus as in the higher plants, though they lie very close together in each cell of the hyphæ.

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The Schools and Pre-Medical Studies

THE writer of the article on "The Schools and Pre-Medical Studies", which appeared in NATURE of November 2, p. 706, very rightly stresses the need for a common syllabus for all First M.B. examinations. He refers to the differences between the London syllabus and the (new) Cambridge syllabus as regards biology. He does not, however, mention the fact that this new Cambridge syllabus is the fruit of the labours of the Joint First M.B. Committee of the Universities of Oxford, Cambridge and London. This Committee produced an agreed list of types to be included in the biology syllabus, "with a recommendation that each University should adopt a syllabus within the common outline". To this, not only Cambridge, but now also Oxford has subscribed. As a result, a schoolmaster will now require only a single course in biology to prepare a boy for the First M.B. at either Oxford or Cambridge; and if, as is very much hoped, the University of London sees its way to accept the report of the Joint First M.B. Committee, a great step will have been taken to secure that uniformity of syllabus which is so much desired. But it should be known that such uniformity is already in existence between Oxford and Cambridge.

It may perhaps be helpful to readers to remind them that the Joint First M.B. Committee of the Universities of Oxford, Cambridge and London is a body independent of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England and the Society of Apothecaries of London, whose report on the Medical Curriculum forms the subject of the article in NATURE of November 2.

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To justify the need for a common syllabus, I was more concerned with the differences between the syllabuses of the First M.B. examinations of Cambridge and London than with the uniformity already in existence between Oxford and Cambridge. The fact that the syllabus issued in September 1935 for the London First M.B. examinations during 1936 is the same as that of previous years appears to afford little hope of a common syllabus in the immediate future.

What is wanted is a common syllabus for *all* First M.B. examinations, and it is to be hoped that the achievement of this aim will not be hindered by the fact that the two distinct bodies referred to by Dr. de Beer have each decided independently what that syllabus should contain.

W. J. R. D.

Points from Foregoing Letters

A MARKED inhibition of the growth of implanted tumours in rats is found by A. Haddow when colloidal preparations of several benzanthracene compounds and of benzpyrene are injected intra-peritoneally. The same substances are known to produce cancer after prolonged application. The author points out that this behaviour is similar to that of X-radiation, which can both control and produce cancer.

Dr. A. Cohen describes the synthesis and structure of compounds of maleic anhydride and vinylnaphthalenes. These may prove useful in the synthesis of sex hormones of the equilenin and œstrone type.

Neutrons, apparently of medium velocity, from a radon-beryllium source surrounded by a 15 mm. silver shield, produced a greater activity in test pieces of silver and of iodine, and a smaller activity in silicon and aluminium, than that produced by the unshielded source. W. Ehrenberg concludes that collision of neutrons with silver nuclei may result either in capture of the neutrons with formation of a radioactive element, or in the transfer of energy to the nucleus (excitation) and consequent slowing down of the neutron. The reduced energy of the neutron is different from, and greater than that of, the neutrons slowed down by paraffin wax.

A table showing the radioactivity of ferro-manganese concretions and deposits obtained from seas and lakes of the U.S.S.R. is given by L. M. Kurbatov. The percentage and the relative proportions of radium, mesothorium I and thorium X in the separate layers of the concretions may give an estimate of the rate at which such concretions are formed.

A mechanical relay and spark counter (for counting alpha and beta particles) is described by Dr. H. Teichmann. It consists of a piece of spring steel and a copper sheet covered with a thin layer of mica, and it is claimed that it has certain advantages over the similar water-jet device devised by Greinacher.

H. C. Bhuyan reports that the diamagnetic susceptibilities of chlorine, bromine and iodine vapours are temporarily increased on exposure to visible light. Only a small increase is produced by the red end of the spectrum, but this becomes greater at the violet end.

Prof. T. F. Dreyer enumerates the stratification of layers at Mossel Bay, South Africa, bearing various phases of prehistoric implements of Stellenbosch culture. He disagrees with O'Brien's correlation of the Stellenbosch culture with the East African Early Acheulean, because it would indicate that human history commences at a very much later date in South than in East Africa.

Phloridzin, a bitter principle obtainable from the bark of apple and other trees, has been found to inhibit the reaction between the phosphate radicle and glycogen, the sugar-like substance in the muscle, the oxidation of which provides energy to the organism. H. Kalckar now points out that phloridzin also inhibits another reaction, namely, the oxidation-reduction ('dismutation') of triosephosphate into phosphoglyceric acid and glycerophosphoric acid.

Dr. K. Mellanby and Dr. P. A. Buxton direct attention to the occasional emanation, under the influence of moisture, of a poisonous gas from rubber washers used to seal the jars in which living insects are kept. This may vitiate experiments such as those on the influence of humidity upon the tsetse fly.

Research Items

Racial Origins of the American Aborigines

ARGUMENTS which have been advanced recently, based primarily on somatological evidence, in support of the view that Melanesian and Australian elements are to be found in the indigenous peoples of America, have induced Dr. Aleš Hrdlička of the Smithsonian Institution, Washington, D.C., to recapitulate the evidence and to examine the validity of the conclusion (*Smithsonian Misc. Collect.*, 94, 11). The supporters of the theory rely mainly on the evidence of skeletal material from Lagoa Santa, Brazil, Lower California and Patagonia, but recently the evidence of linguistics and culture has been invoked. So far as the argument from physical characters and skeletal material is concerned, it was pointed out by de Quatrefages and Ten Kate that certain crania, recognised as of primitive type, presented close resemblance to Melanesian and Australian skulls; but they did not go on to deduce racial affinity therefrom as subsequent theorists have done. These theorists, and popular writers following them, have given the presence of the Melanesian and Australian elements more and more of a reality until the belief has assumed the semblance of a demonstrated fact. As the result of a study of 10,000 American crania, personal visits to more than a hundred tribes in America and the study of a larger number of Australian skulls than any other man, the author is unable to accept the theory. The basic foundations of the theory are built on sand. So far as the skulls from Lower California are concerned, these skulls do bear a resemblance to some of those of Melanesia; but this type is found also in not a few other widely separated regions of America, both among Indians and Eskimo. There it is contemporaneous with other types of these people, connects with them, and is only one of several.

Romano-British Gloucester

FURTHER evidence of the culture of Romano-British Gloucester is afforded by pottery from two sites in the city, which has been described by Mr. Charles Green (Public Museum, Gloucester, Occasional Papers No. 3, 1935; 2*d*.). The first group, of which part has recently been acquired by the Museum, was found in excavating the foundations of the girls' school at the corner of Denmark and Lansdown Roads. It has been ascribed to the period A.D. 250–300, but this dating is too late. The potter's mark *off. Calvi*, referring to the factory of Calvus at La Graufesenque, fixes the date of manufacture in the period A.D. 54–94. The evidence afforded by the collections in the Museum, mostly unpublished, points to the introduction of *terra sigillata* into Gloucester during the Flavian period. The coarse ware here described falls into well-known types, most of which are dateable and can be compared with dated pottery from other sites in the district. Most of it is late Flavian. The second group is from a double interment found in the garden of a house in Dean's Way. Iron nails, some showing traces of wood, were found, which possibly had belonged to a coffin. Other fragments of iron were with parts of a small bronze bowl, for which it is difficult to find a parallel, as unlike the bronze pans of the period, it has no traces of handles. The pottery is in a fair state of preservation. A bulbous beaker belongs to a type which did not appear earlier than the beginning of the fourth century, while a pseudo-Samian bowl is also late. The jars belong to a type which persisted throughout the whole Romano-British period.

Psychology and Nutrition

AN article by David Katz on "Some Problems of Feeding in relation to Industrial Psychology" appears in the *Human Factor* (9, No. 4). The writer stresses the difference between rational and irrational aspects of nutrition. Man manages, in normal circumstances, to obtain a sufficient quantity of the basic substances of his diet as protein, carbohydrates and fats together with nutritive salts and vitamins, but the way he gets them is entirely at the mercy of the particular taste or preference that has been developed by the nation, race or climate, in which religious taboos, tradition and subconscious factors play an important role. Mr. Katz refers to the international results of the Japanese food habits compared with those of the Europeans; to Germany's errors in food policy during the War; to the increasing 'democratisation' of food; sex differences; and changes of taste with age. If it should seem necessary to modify the acquired taste of a people, the administration should always keep in mind the important difference between rational and irrational ways of satisfying human appetite.

New Zealand Whitebait

IN the *Victorian Naturalist* (52, No. 3; 1935) Mr. Gilbert Whiteley gives an account of the Galaxiidae, a family which includes the whitebait of New Zealand and the mountain trout, minnow, jollytail, eel gudgeon or native trout of Australia. They are mostly found in fresh water, from sea-level to the tops of mountains, some, like the whitebait, migrating to and from salt-water, but probably not travelling very far out to sea. The New Zealand whitebait of commerce consists of the young of more than one species which ascend rivers in hordes towards the end of the year. The chief species is usually called *Galaxias attenuatus*, although strictly speaking it should be named *Austrocobites attenuatus*. The breeding habits are peculiar: in spring, countless numbers of these small adult fishes are seen in the lower reaches of the rivers within tidal limits where are mud flats and muddy creeks with salt rushes and stranded brushwood débris. There, ova in huge numbers are laid and cling to the rushes and water plants near the surface of the water. In order that the young may hatch, the ripe ova must be washed from the plants at high spring tides and the newly hatched fry driven out to sea, where they remain for a few weeks and then struggle up the rivers against the current. In the day an advance of a mile in three hours may be made. In the fresh water they remain for a few months and then descend again to breed.

Insects of the Kalahari Expedition

IN the *Annals of the Transvaal Museum*, 7, Part 1, October 1935, are a series of reports on various groups of insects collected by the Vernay-Lang Kalahari Expedition (March–September 1930). Mr. Louis B. Prout deals with the moths of the family Geometridæ. Concerning this group, he remarks that, with the exception of a very few species, contained in the British Museum, from the N'Gami country, no specimens appear to have been previously obtained from the Kalahari Desert and its immediate vicinity. The number of Geometrid species collected was 51, distributed among 34 genera: six species and one subspecies are described as new. In the report of Mr. L. Gschwendtner, water beetles of the families Haliplidæ and Dytiscidæ are discussed. Altogether, 53 species are identified, three being described as being previously unknown, together with one new subspecies and one new variety. Beetles of the family Buprestidæ are reported upon by Dr. Jan Obenberger, who records 36 species, three being previously unknown. Dr. A. J. Hesse deals with the weevils (Curculionidæ). Out of 76 species, four are described as being new while the undetermined forms are represented either singly or belong to groups not sufficiently known at present. The last report, by Prof. T. D. A. Cockerell, is concerned with the bees. A very considerable proportion of these insects are described as new, namely, 29 forms out of a total of 62 species. The various reports make a substantial contribution to a knowledge of the fauna of a region of notable biological interest.

Role of Organic Matter in Plant Nutrition

CONTINUING the series of researches on the above subject, three further papers by Subrahmanyan and his associates have appeared (*Proc. Ind. Acad. Sci.*, 1, No. 12). These deal respectively with the economy of carbon during decomposition of cane molasses in swamp soil, the influence of fermentable organic matter on the transformation of iron, and the relation of the oxidation of organic matter in the soil to plant assimilation. Addition of molasses to water-logged soil was accompanied by much loss of carbon in gaseous forms, and still greater loss occurred after flooding. The distribution of total carbon was not appreciably affected by the concentration of molasses. Flooding removed the bulk of the organic matter in all cases. Fermentation and loss of carbon were increased by increase of temperature and access of oxygen. It is suggested that in the growing of rice it would be advantageous to convert the bulk of the added organic matter to insoluble forms before flooding. Addition of fermentable organic matter to swamp soils brought quantities of ferrous iron into solution, the amount varying with different soils, whilst insoluble ferrous iron in the soil sediment increased in all cases. Increasing concentration of organic matter increased the amount of ferrous iron brought into solution, and solution and subsequent precipitation were hastened by rise of temperature to 45° C. Evidence is presented to show that ferrous iron in solution is largely present in association with organic acids produced during fermentation, whilst insoluble ferrous iron is present as carbonate and sulphide. A survey of tropical soils showed most of them to be poor in organic carbon compared with soils from temperate regions. Addition of minerals may increase or depress the beneficial effect of organic manuring.

Fossil Fishes of Sokoto Province

DR. E. T. WHITE has described collections of fossil fishes collected by the officers of the Geological Survey during the course of water supply investigations in Sokoto Province (Geological Survey of Nigeria, Bull. No. 14, 1934). Two very distinct faunas are present, one from the Upper Cretacean, the other from the Lower Eocene. The material consists largely of isolated teeth and bones, but there are a number of skulls of bony fishes, chiefly cat-fishes (Siluroids) which still abound in this region and are a characteristic feature of the modern fauna. These fossil forms, however, cannot be referred to any living genera, therefore new genera have been established for them. The fishes from the Upper Cretaceous fauna include a Porbeagle shark (*Lamna*) of the same type as the living species, and a curious genus of saw-fishes (*Schizorhina*) of which no representatives have survived. Sokoto Province at the time when they lived was probably a tropical or sub-tropical sea. In the early Eocene period the deposits were coastal and the fishes were mainly sharks and rays and also cat-fishes. The cat-fishes very possibly did not actually inhabit the brackish waters in which the beds were formed, but are likely to have been carried down the rivers to the coast when dead or in a dying condition. Figures of the nearest living relatives of most of the fishes are given and there are several good text figures and photographic plates of the bones and teeth.

Origin of Copper Deposits

A GROUP of copper-bearing pyrrhotite veins of the Ducktown type and genetically related ore-bodies are widely distributed in the southern Appalachian region. The origin of these is the subject of a contribution by C. S. Ross (U.S. Geol. Surv., Prof. Paper 179; 1935) which is of particular importance on account of the valuable discussion which it contains of replacement phenomena and the criteria by means of which mineral sequences can be determined. A magnificent series of forty-four plates illustrates the evidence most convincingly. The veins are thought to have been derived from a differentiating magma, but no parental igneous rock has been traced in the region. The first event in vein formation was the intrusion of a felspathic magma. This was followed by introduction of vein quartz, after which followed a stage characterised by a large group of ferromagnesian minerals. Replacement of quartz by hornblende and actinolite is of particular interest. In most of the veins, this stage was succeeded by one in which calcite was the dominant mineral, associated in some cases with later dolomite and ankerite. There is good evidence that the carbonates do not represent replaced limestone, but are hydrothermal deposits. A small group of silicates followed and replaced carbonates, and finally (with insignificant exceptions) sulphides were introduced and replaced carbonates, quartz, felspars, ferromagnesian minerals and schists. As regards the physical chemistry of the processes involved, our knowledge is woefully deficient, and after a lengthy discussion the author is obliged to confess that the character, concentration and reactions of the volatile substances that formed the solvents and the transporting agents for the vein materials are little understood. As a demonstration of replacement, however, the occurrences described are of fundamental petrological importance, since there is a steadily growing body of evidence that certain

igneous rocks, commonly thought to be crystallisation products from magmas, may actually be complex metasomatic replacements of pre-existing crustal materials.

The Asama-yama (Japan) Eruption of 1935

FOR more than two years since the explosions of 1932, the volcano Asama remained inactive. In October 1934, however, the floor of the crater began to rise at the rate of about 8 in. a day, and the surface of the ground at the Volcano Observatory, three miles east of the crater, showed a considerable tilting. These changes were the preludes of the series of eruptions, in April and May 1935, that are now described by Mr. T. Minakami (*Bull. Earthq. Res. Inst.*, 13, 629–643; 1935). The first and greatest eruption occurred on April 20, and was followed by forty others until May 28. During the explosions, the crater floor was broken up, and bombs, weighing altogether 4½ million tons—one of them 200 tons—were scattered over the surface of the cone. Ashes fell over a narrow zone entirely to the east of the volcano and including Tokyo and Tiba. In the same direction, there was no trace of a silent zone in the sound-area, but towards the north, west and south the zone was clearly developed, the boundary of the inner sound-area having a mean radius of 30 miles, while the boundaries of the outer area had mean radii of about 90 and 150 miles. During March, the ground of the Observatory tilted at the mean daily rate of 1·5″ towards the south-east. On April 17, the direction of tilting was reversed, and on April 20, the tilt was 2·5″. Another reversal occurred on May 2, and, after that, the daily rate of tilt began to decrease. It is interesting to notice that extraordinary tilts of the ground were invariably accompanied by violent explosions.

Physiology of Illumination

IN a paper read to the Illuminating Engineering Society on November 12, Dr. R. J. Lythgoe said that the eye can function over a range of illuminations between 0·00001 and 10,000 foot candles. It has been recently shown that even in occupations only requiring the crudest visual perception, the work is speeded up by an increase in illumination. Extremes of contrast are subjectively uncomfortable, and so it is advisable not to have a great difference in brightness between the task and the surrounding field of vision. It was stated that a single 'glaring' source of light hanging on a black wall near a visual test object may actually improve the perception. The general increase in the standards of artificial illumination is in keeping with the more generous economic outlook of to-day. Along with the rise of the level of living there has been an increase in the illumination of factories. Before the Great War, four foot candles was the minimum recommended; it is now ten foot candles. So far as evidence goes, the standard of illumination seems to be continually rising. The limit is governed by technical and economic reasons. Skill is necessary to make a little go a long way. Anyone can take a snapshot out of doors in 5,000 foot candles, but skill enables us to arrange lights indoors so that a good portrait can be obtained with 100 foot candles only.

Miniature Thermionic Valves

THE midget type of three-electrode valve referred to in NATURE of October 27, 1934, is now accompanied by a pentode of the same general form and construction. These 'acorn' tubes, as they are known in the United States, have been developed by the R.C.A. Manufacturing Company, and a brief, illustrated description of them and their characteristics is given in a paper by B. Salzberg and D. G. Burnside in the October issue of the *Proceedings of the Institute of Radio Engineers*. On account of the decreased impedances of the leads and the lower inter-electrode capacities and transit times, these valves permit of considerable improvement to be made in receiving equipment for ultra-short wave-lengths. The triode can be operated as an oscillator in a conventional circuit down to a wave-length of about 40 cm., while the pentode can be used as a radio-frequency amplifier at wave-lengths down to about 70 cm. It is claimed that, at a wave-length of three metres, these pentodes enable an amplification of 10–15 times to be obtained under conditions at which the ordinary valve would be quite useless. The small size of the valves and their novel structural arrangements permit the construction of compact and convenient receiving apparatus. Even at longer wave-lengths, the excellent characteristics of the valves make them applicable to purposes where their small size and low weight are of importance.

Reaction of Hydrogen with Oxygen

MANY investigations have been made of the reaction of hydrogen atoms with oxygen molecules, but it has remained uncertain whether the reaction $H + O_2$ occurs as a two-body or as a three-body process. G. A. Cook and J. R. Bates (*J. Amer. Chem. Soc.*, 57, 1775; 1935) have reinvestigated the reaction, the hydrogen atoms being obtained by the photo-dissociation of hydrogen iodide. A similar study was also made of the reaction between deuterium iodide and oxygen. It was found that, in parallel runs, more deuterium is oxidised than hydrogen, and that addition of nitrogen greatly increases the oxidation of hydrogen or deuterium. The results indicate that the reaction between hydrogen atoms and oxygen molecules is a three-body process. An analysis of two possible reaction mechanisms is made. It is also concluded that Steiner's value for the velocity coefficient $k_{H + H + H_2}$ is to be preferred to the very different one given more recently by Smallwood.

Structure of Elliptical Nebulæ

THE true nature of the elliptical nebulæ is at present a problem of considerable difficulty, partly owing to the lack of sufficient observational data on which to found a satisfactory theory. With the object of remedying this deficiency, Sinclair Smith (*Astrophysical J.*, 82, 192) has recently made observations of polarisation, nuclear size and spectral character in Messier 32, a nebula which is regarded as typical of its class. He has found a definite nucleus of diameter approximately 0·8″, but no detectable polarisation within 75″ of this nucleus. The spectral type is *dG*3 and shows no variation along the major axis. Much work remains to be done on these lines; but at present the observations do not support Jeans's gas-sphere model, or ten Bruggencate's hypothesis of an assembly of small particles illuminated by the nucleus. It is suggested that a star cluster model accounts best for the facts, though the resulting central density of $8 \cdot 8 \times 10^5$ stars per cubic parsec is extraordinarily high.

International Exhibition of Chinese Art

THE exhibition of Chinese art, which opened at the Royal Academy of Art, Burlington House, Piccadilly, London, on November 28, is a unique opportunity for student and connoisseur alike. No such collection of objects from the Far East has ever been gathered together in Europe before; and it is an opportunity that is not likely to recur. Nearly four thousand objects are shown, of which every one is of interest, either for its æsthetic excellence, or for its historical significance.

The nucleus of the exhibition is drawn from the Chinese national collections and has been selected from the Imperial treasures which came from the Forbidden City. Not a few of these were made specially for palace use, and bear the emperor's commemorative inscription. In addition, exhibits have been contributed from public and private collections in Japan and the United States, and among European countries, Great Britain, France, Germany, Sweden, Russia, Turkey and the City of Danzig. Even Egypt has helped. In fact, every effort has been made to secure that the exhibits should be as fully representative as possible.

The range of the exhibits is almost as varied as the sources from which they have now been brought together. Every side of Chinese artistic achievement has been covered—in all instances adequately to meet the needs of the student, in many with abundance. Bronzes, carpets, enamels, embroideries, glass, ivories, lacquer, paintings, calligraphy, sculpture, textiles, and, needless to say, numerous examples of the most characteristic products of Chinese culture, jades and pottery and porcelain, all are shown at the highest point of attainment in technique and artistic development in the respective periods.

The exhibition has been arranged on a chronological basis, in dynastic periods. Some idea of the impressive character of Chinese civilisation will be gathered from the fact that the exhibits, of which the earliest in date may well stand comparison in artistic merit with later objects in their own class, cover a period of no less than thirty-five centuries, ending at A.D. 1800 and beginning with the Bronze Age at about the middle of the eighteenth century B.C. This is a record with which not even Egypt, with all its long history, can compete.

In an exhibition such as this, in which the principle of selection has been either purely æsthetic or relative to the history of artistic development, the objects shown are unfortunately but necessarily divorced from their cultural context—an association of the greatest importance, as all will admit, who have any acquaintance with Chinese culture. Of the purely æsthetic aspect of the exhibition, NATURE may well leave others to speak. It is far from being without significance for scientific studies.

The ethnologist, and still more the archæologist, will find much of supreme interest and no little importance here. This indeed is no more than might be expected when so long a period of development is covered. The ethnologist, for example, will note the early appearance in the bronzes of the Shang-Yin dynasty (? 1766– ? 1122 B.C.) of the characteristic feeling of China for form and ornament, as well as the delicacy of handling in technique. Nor will he overlook how, notwithstanding ethnic movement at various periods, after being influenced for a time, these qualities reassert themselves, except possibly in the last period under the Manchu dynasty, when the effect of influences making for an elaboration of form and colour seem to have been unusually prolonged. This persistence of the native stamp may perhaps be appreciated most readily in the sculptures and figures of the T'ang period (A.D. 618–819), when Chinese Buddhist art, purified from corrupting elements by fresh contacts with India through the Chinese pilgrims who journeyed to that country, rapidly reasserted its native qualities in the imported art forms. It is perhaps scarcely necessary to add that the objects belonging to the earlier dynasties, and especially the human figures, coming from burials, are of the greatest significance for Chinese religious belief, legend and domestic culture.

To the archæologist and student of prehistory, the interest of the exhibition, especially in the chronologically earlier sections, is even greater. Early Chinese history in its annals is obscured in the mists of time. The records of the emperors and of their achievements stretch well back into the third millennium B.C. Until recently it had been held—and even then with some doubt—that authentic history did not begin at the earliest before the Chou dynasty (? 1122–249 B.C.). Excavation, however, which began with a Japanese expedition in 1906, was continued by Dr. J. C. Andersson after the Great War, and recently has been prosecuted with vigour by the Chinese themselves, has revealed the existence in North and Central China of a chalcolithic civilisation, which followed on a neolithic culture ending about 2000 B.C. It would appear from recent research that this chalcolithic civilisation reached, or at least influenced, southern China about the beginning of the Chou dynasty, or slightly before (see NATURE of August 31, p. 346). Among the objects of this early culture there appears a painted pottery, apparently belonging to the groups of early painted pottery which have been found in eastern Europe, western Asia, Baluchistan and northern India. In China it appears to be an intrusion which dies out, a second type of unpainted ware being the characteristic form, persisting through the later period.

Interesting as this early civilisation undoubtedly is in view of its possible Western affinities, its connexion with the period which follows, on present evidence, is of no less moment. For it is to be noted that the early ceremonial bronzes and other objects of the Bronze Age from recent excavations, some of which are inscribed, appear to confirm the records of the emperors of the Shang-Yin dynasty in the annals previously regarded as legendary.

Unfortunately, it has not been possible to do more than refer in passing to the remarkable series of exhibits of the T'ang period, perhaps China's age of greatest expansion. Here the most noteworthy exhibits are the paintings recovered by Sir Aurel Stein from Tun-huang; but the whole exhibit of this period is of the greatest importance for the student of cultural contacts between East and West, notably in the sculpture, where Greek influence still lingers, permeating through India after many centuries.

Lenses Employed in the Technicolor Process of Cinematography

By H. W. Lee, Research Department of Taylor, Taylor and Hobson, Ltd.

IN colour photography it is necessary to analyse the light reflected by coloured objects into at least three spectral regions which, where there are three only, may be termed red, green and blue respectively. This is done by means of colour filters which transmit definite portions of the spectrum and absorb the rest; the three negatives are produced either successively or simultaneously. In cinematography the negatives must, of course, be made simultaneously unless the rate of movement of the film is increased threefold, to which there are grave objections. The three negatives may be made simultaneously by means of three lenses; this results in colour parallax, and the three images will never exactly superpose. Alternatively, the beam of light issuing from a single objective must be divided. This division may be made by means of superposed filters, the components of white light being successively subtracted and acting on sensitised films superposed. The objections to this are that the films and filters must be very thin if the composite 'tri-pack' and filter film is not to be too thick, and that each layer of emulsion produces a certain amount of scattering, so that the successive images are more and more diffused. Other methods of dividing the beam are by successive reflections from thin, partly-reflecting and partly-transmitting films, which may be either isolated films of collodion or films of silver on glass surfaces. The silver may be in the form of totally reflecting films partly covering the surfaces they are deposited on, a method not without objection since the areas of film must be small if there is not to be differentiation between different parts of the light beams; alternatively, the silver films may be so thin as both to reflect and transmit.

The Technicolor process is, optically speaking, a combination of two processes suggested above. One semi-reflecting metallic film on the diagonal plane of a glass cube is combined with a bi-pack, to which the objections of the tri-pack do not altogether apply, as the two sensitive films can be placed in contact.

The glass cube placed between the lens and the film has considerable thickness (being approximately equal to the size of field covered) and therefore produces considerable aberration. This fact was not sufficiently realised by early experimenters in colour photography, who tried to combine prism 'beam splitters' with normal lenses on the market, which of course had not been computed for use with considerable thicknesses of glass. The result was poor definition and images of unequal sizes. Technicolor, however, early realised the necessity for taking the prism into account in the design of the lens system, and in 1918, D. F. Comstock took out a patent (British patent 131,422) for several constructions, having apertures up to $f/3\cdot9$, for lens systems combined with prisms. In 1927, however, their prism system was simplified and the need felt for lenses of larger aperture, owing to the change in cinema technique from outdoor to studio photography. Technicolor approached Taylor, Taylor and Hobson, Ltd., who were making lenses having an aperture of $F/2$, and asked them to design a special lens for their needs. This was for two-colour work. With the change to three-colour work in 1931, a further change was needed, and, moreover, the matter of colour correction became more stringent.

It is possible to equalise the focusing position and the focal lengths for two parts of the spectrum which would, in practice, be the 'centres of gravity' of the spectrum bands passed by the two filters used, but when three colours are in question there is the difficulty that the third colour must necessarily be out of focus owing to the so-called secondary spectrum. This secondary spectrum can be reduced in certain optical systems such as telescopic objectives and photographic lenses of small aperture by the aid of special glasses; but the dispersive power of these glasses, the so-called 'telescope flints', which have partial dispersions more nearly proportional to those of crown glasses than the flints in ordinary use, is so low that, in photographic systems of large aperture and considerable field dependent entirely upon these glasses, the construction is prohibitively complicated. However, since, in the new Technicolor process, only two images are formed in a plane at right angles thereto, it is possible to allow for the slightly different focus for the green, if the foci for the red and blue coincide. These, then, were the conditions to be fulfilled; the red and blue foci must coincide, the tolerance being that the blue focus might be 0·0005 in. longer than the red as the blue negative is the rear one of the bi-pack. The green focus could be 0·003 in. shorter than the common focus for the blue and red. These conditions were for the 'standard' focal length of 50 mm. The aperture required was $F/1\cdot7$. As there is inevitably some loss of definition in colour processing, the definition of the lenses was to be better than that of lenses for non-colour work. Other lenses of focal length 70 mm., 100 mm. and 140 mm. were also required.

Now the 'secondary spectrum', which required an adjustment of 0·003 in. for the green on the 50 mm. lens, increases with focal length, so that it becomes 0·008 in. with the 140 mm. lens, while the 'adjustment', being made on the camera, is fixed. It thus became necessary to reduce the secondary spectrum with the longer focus lenses. Fortunately, the Parsons Optical Glass Co. (now Chance-Parsons) came to the rescue with a new glass; an experimental melting produced a glass having a reduced secondary spectrum and having the low V of 44·9 (as against 52·2 in the old 'telescopic flint'). By judicious incorporation of this glass in one or two components in the longer focus lenses, these were designed to give approximately the same difference between the green focus and the red-blue focus, as in the standard lens.

A further interesting problem arose when short focus lenses were required, because, with normal types, there is not sufficient clearance between the lens and the focal plane to accommodate the prism. Mr. J. A. Ball, of Technicolor, had tried placing a negative lens in front of an ordinary cinematograph-

taking lens, the distance between the two being greater than the focal length of the positive lens; thereby he decreased the focal length and at the same time displaced the nodal plane towards the focal plane, giving greater clearance.

A negative lens so placed, however, introduces considerable barrel distortion. Ball reduced this by using two negative components, each a cemented doublet, but when the problem was put to Taylor, Taylor and Hobson, Ltd. to provide a lens of aperture $F/2$ free from distortion, a complete solution was forthcoming with a negative consisting of only two simple elements. Fig. 1 shows the Taylor-Hobson lens. The same stringency as to colour correction, of course, applies to this lens.

The closeness of the limits for colour correction necessitates special precautions in manufacture. In a batch of lenses made to very close tolerances of radius and thickness and made from identical glass melts, it is rare to find the chromatic corrections identical to the Technicolor specification, owing to small variations in the composition of glass throughout the pot. The assembled lenses are first tested for focus throughout the spectrum on a collimator illuminated through a constant deviation prism. If necessary, alterations are then made, to bring the

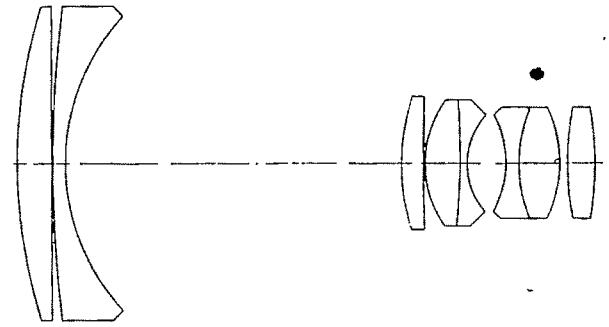

FIG. 1.

chromatic corrections right. Finally, a photographic check is made. An inclined object consisting of parallel lines is photographed through the actual colour filters used by Technicolor.

Bacteriology of the Atmosphere*

THE study of the bacteriology of the atmosphere dates back to the time of Ehrenberg, who published twenty-five papers dealing microscopically with dust and its biological concomitants in the air. The great impetus to the study was, however, the controversy over the question of spontaneous generation, with which the name of Pasteur is indelibly associated. He was not, however, the pioneer in this respect, for Gaulthier de Claubry in 1832 and Baudrimont in 1855 had already given definite experimental proof of the existence of living 'germs' in air, capable of provoking decomposition. It was the experimental genius of Pasteur which eventually settled the controversy beyond all doubt, and incidentally opened the eyes of scientific workers to the existence of a circumambient flora of unknown potentialities.

The epoch-making development of these discoveries lies in the antiseptic surgery of Lister. Researches on the sanitary quality of air multiplied exceedingly at this period, but, while much of scientific interest was revealed, the general result was to make clear that among the numerous organisms suspended in air and capable of growth, there were, as a rule, very few of pathogenic or of surgical importance. For this reason, there has been of late years a considerable waning of medical interest in the air-borne flora, to the point of positive neglect. Yet, while the above statement may be true of the surgical aspect, there is no doubt that from the physician's point of view, air-borne infection is, in certain cases, of primary importance. This is particularly true of pulmonary diseases.

Some excuse for this state of affairs may be found in the comparative dearth of knowledge about the conditions under which aerial organisms live and survive to convey infection. A few investigations have been carried out on the viability of organisms in sand or dust or suspended in water droplets; but it is still true to say, for example of the tubercle bacillus, that there is no exact knowledge of the conditions under which it can or cannot survive when floating freely in air.

If this is true of such special cases, of vital importance to man, how much more does it apply to the generality of air-borne organisms—the aeroplankton—not only of living rooms, etc., but also of the atmosphere as a whole. The biological side of oceanography has been impressively developed during this century, but the biological side of meteorology remains an unexhausted field for investigation. It has been too rashly assumed that the atmosphere cannot offer a permanent home to micro-organisms, and that those which are found there are strayed wanderers from their true homes and are either dead or in some dormant, spore form.

Investigation makes this much less certain. The number and variety of organisms found are sometimes very great, and they are in many cases not referable to types found elsewhere. Moreover, spore-bearing types are relatively rare, at least among the bacteria and the yeasts, though many fungal spores have been found. The latter have been investigated chiefly in Canada and the United States, in connexion with the spread of rust infections on crop plants, and their migrations have been traced, to some extent.

The distribution of organisms in the atmosphere is not a simple function of height, as earlier observers thought. Aeroplane surveys have made it clear that micro-organisms occur in sporadic clouds, like those of ocean plankton, which may be found at any height that has so far been investigated, that is, up to 20,000 ft. If it be true that the atmosphere does not provide permanence of vital conditions, yet it does provide undoubtedly continuity, so that there are at all times and places some portions of the atmosphere

* Substance of a Chadwick Public Lecture delivered by Prof R. C. McLean on November 19 at the London School of Hygiene and Tropical Medicine.

in which organisms can live. Condensation of moisture takes place very readily on such small objects, and it is significant that the largest catches have been reported from just below the base of clouds, where saturation conditions obtain. In the like situations, multiplication of organisms may take place to such an extent as to give rise to a veritable cloud flora and perhaps to account for the many instances of rains of small organisms for which no terrestrial source has been reliably indicated. Even apart, however, from such favourable conditions, it is quite possible for micro-organisms to live, surrounded by condensation droplets, even at great heights. Many, if not most, are protected from the lethal action of ultra-violet rays by red or orange pigments which screen the living matter and also warm it by absorption of heat rays, so that they may survive anywhere below the ozone layer, even at air temperatures well below zero. All the elements necessary for nutrition may be obtained in the air in quantities sufficient for the exceedingly small weight of the aeroplankton. Formaldehyde and radioactive material are also present, and may play a part in stimulating growth.

When one considers the heavy contributions that air deposits make to the soil, even in country districts, there is seen to be no more reason for regarding the soil as the origin of the air flora than vice versa. Dust is in fact the mother substance of the soil.

Methods which will combine both qualitative and quantitative results still need to be worked out, and particular stress may be laid on the need for variety of growth-media and for prolonged incubation periods, since many aeroplankton organisms are of very delicate growth. Until we know why this is so and how such apparently delicate organisms can survive in the atmosphere, we are not likely to have a full understanding of the conditions of air-borne infection.

Educational Topics and Events

BIRMINGHAM.—Prof. Kenneth Neville Moss, professor of mining, has been elected to succeed Prof. Stiles as dean of the faculty of science.

Dr. E. L. Hirst has been appointed reader in the chemistry of natural products.

Work on the foundations of the new chemistry block has begun.

CAMBRIDGE.—At Clare College, J. D. Boyd, University demonstrator in anatomy, has been elected into a fellowship.

The governing body of Emmanuel College invites applications for a research studentship which will be awarded in July 1936. Applications must be sent to the Master, Emmanuel College, Cambridge, in time to reach him not later than June 30. Preference will be given to candidates who have already completed one, but not more than two, years of research. The studentship, which must be held at Emmanuel College, and has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. The studentship is not tenable by a woman or by a graduate of the University of Cambridge.

LONDON.—Dr. Eric Boyland, since 1931 physiological chemist at the Research Institute of the Cancer Hospital, has been appointed University reader in biochemistry, and Dr. V. B. Wigglesworth, since 1926 assistant in the Department of Entomology at the London School of Hygiene and Tropical Medicine, has been appointed University reader in entomology.

OXFORD.—On November 23, Dr. R. T. Gunther in his lecture on the "Early Men of Science of Magdalen College" suggested that the natural amenities of the site may have attracted the attention of Edward Wotton and others to zoological studies, just as in the seventeenth century the foundation of the Botanic Garden on the College land stimulated an interesting group of botanists, among whom were William Browne, Stonehouse, Hooper and Drope. Cartwright, of power loom fame, Gowin Knight, maker of strong magnets, Charles Daubeny, vulcanologist, chemist and botanist, and Lord Rosse, were among the distinguished forerunners of the modern succession of eminent Waynflete professors now attached to the College.

The honorary degree of D.C.L. was conferred upon Sir Harry McGowan, chairman of Imperial Chemical Industries, Ltd., on November 23.

ST. ANDREWS.—Mr. R. C. Alexander has been appointed to the chair of surgery in the University, vacant through the death of Prof. John Anderson.

THE result of the parliamentary elections to the three seats for the Combined Scottish Universities was announced on November 25. The following were elected: Prof. J. Graham Kerr, formerly regius professor of zoology in the University of Glasgow (Unionist); Dr. G. A. Morrison, formerly headmaster of Robert Gordon's College, Aberdeen (National Liberal); and Mr. A. Noel Skelton (Unionist). The death of Mr. Skelton on November 22 will cause a by-election.

THE following scholarships, which are tenable for three or four years, will be offered by the Institution of Naval Architects for competition in 1936: *Naval Architecture: Martell*, £130 a year; *Trewent*, £125 a year; *Denny*, £75 a year. *Marine Engineering: Parsons*, £150 a year; *Yarrow*, £100 a year; *Denny*, £75 a year. The Denny scholarships are tenable for four years at the University of Glasgow only. Full particulars can be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE Association of University Teachers has written to the Rumanian Legation in London in reference to Prof. Pierre Constantinesco Iasi, professor of the history of art in the Faculty of Kichinev, who is stated to be undergoing trial on a charge of conspiracy against the State following his activities against war and fascism, activities which it is claimed have been carried out in a public and legal manner. The Association expresses the hope that the outcome of the trial will be such as to make it clear that the right of freedom of speech for university professors is upheld in Rumania, and quotes from a resolution adopted by its Council on December 14, 1934, in the course of which the Association affirms "the right of university teachers to the full exercise of their functions and privileges as citizens. It maintains that the public expression of opinion, within the limits of the law, on controversial matters is in no way incompatible with the position and responsibilities of a university teacher, it being understood that such expression of opinion is personal and does not commit the Institution to which he belongs."

Science News a Century Ago

Anniversary Meeting of the Royal Society

THE anniversary meeting of the Royal Society was held on November 30, 1835, J. W. Lubbock, vice-president and treasurer, being in the chair. The secretaries' report stated that the Copley Medal had been awarded to William Snow Harris for his "Experimental Investigations of the Forces of Electricity of high Intensity", while one of the Royal Medals had been awarded to Michael Faraday for his "Experimental Researches in Electricity" and the other to Sir William Rowan Hamilton for papers published by him in the *Transactions of the Royal Irish Academy*, vols. 16 and 17, entitled "Supplement to an Essay on the Theory of System of Rays". The report also announced the appointment of Mr. Robertson as assistant secretary "at a salary of £160 per annum with the use of a bed-room, sitting-room, coals and candles", and of Mr. Schuckard as librarian at a salary of £50 per annum. Mr. Schuckard was to attend from 12 to 4 o'clock on two days of the week. The Society consisted of 10 Royal personages, 48 foreign members and 735 home members, of whom 598 had compounded for life.

Culture of Grapes by Lord Tyrconnel

AT a meeting of the Horticultural Society on December 1, "a paper was read containing notes and observations on many kinds of grapes, cultivated at the seat of the Earl of Tyrconnel, near Catterick Bridge, in Yorkshire, the vineries at which place seem very rich in varieties of this fruit, placed under circumstances highly favourable for comparison; any remarks like these, have been the result of long experience by Mr. Whiting, Lord T's gardener, cannot fail to aid in clearing up the confusion which reigns over the nomenclature, etc. of nearly 200 supposed different sorts of grapes, and further the establishment of a standard of certainty among so much conflict of opinion". (*Athenæum.*)

The London Mechanics' Institution

ON Friday, December 4, *The Times* recorded that this Institution held its usual quarterly meeting on Wednesday evening, in its theatre, Southampton Buildings, Dr. Clutterbuck, vice-president, being in the chair. A report of the committee of managers said that the present number of members was 1,211, an increase of 180 on the preceding quarter. The funds of the Institution appeared to be in a prosperous condition, between £200 and £300 having been paid to lecturers during the preceding twelve months. The chairman congratulated the meeting on the Institution having arrived at its twelfth anniversary, and said he believed a more favourable report on its condition had not been presented before. Votes of thanks were given to Dr. Birkbeck, the president, for his exertions on behalf of the Institution, to lecturers and teachers of classes who had given their services free of charge and to the donors of books, etc.

Education in Italy

IN its column of Weekly Gossip on Literature and Art, the *Athenæum* of December 5 said, "In Italy, Silkworms, Wine-making and Education seem to occupy public attention. Silkworms, it appears, are subject to some sort of infection disease, the nature of which it is important to discover, that precautions may be taken to guard against it. . . . The attention to education we have before noticed; since then, we have seen announced in the periodicals, a 'Manual of Instruction for Infant Schools', a 'Course of Instruction for Girls', and more books for the use of young persons than we can recollect, besides sundry essays upon the subject of Education. We trust, therefore, that the rising generation of Italians will improve accordingly. . . . From Sicily we learn that not less than nine periodicals literary and scientific now flourish there. . ."

Electrostatics: Faraday Borrows a Copper

"HAVE borrowed a copper from Mr. Kipp. It is a new one, not quite finished, and having no cock fixed in it, so that its shape and condition is regular" Thus wrote Faraday on December 5, 1835, and with the borrowed copper proceeded to make the first of his electrostatic experiments. The vessel, a large one of 31 inches diameter, was set up on an insulating stool and charged by means of a frictional electrical machine. Then with a carrier ball—a small sphere covered with tinfoil and suspended by a silk thread—he examined the state of electrification at various points of the surface inside and outside the copper. The surface was touched and the charge taken by the ball transferred to a test electrometer. A series of trials soon showed him that projecting parts of the outside, for example, the edge or rim of the copper, were the most highly electrified. Very little electricity could be obtained from any point inside: the walls near the top were feebly charged, but the bottom showed no charge at all.

Societies and Academies

LONDON

Royal Society, November 21. A. R. UBBELOHDE, J. W. DRINKWATER and A. EGERTON: 'Pre-knocks' and hydrocarbon combustion. Former arrangements for sampling the gases from the engine cylinder have been so modified that the samples can be taken when ignition is made to occur every alternate cycle either in the firing or non-firing strokes. Aldehydes are formed at the end of the compression stroke in the non-fired cycle, but the concentration is much smaller than in the firing stroke. The quantities of formaldehyde and of total aldehydes have been measured when running on various fuels; the amounts produced are insufficient to account for 'knock'; for this, another source of peroxides is therefore needed. Experiments are described which suggest that most hydrocarbon fuels can be made to 'knock', provided molecules which can disrupt and give rise to a branched chain reaction are produced or made available. The main source of the nitrogen peroxide found in the previous experiments is probably the hot active surface of the exhaust valve, and is proved not to be the flame. D. T. A. TOWNEND and E. A. C. CHAMBERLAIN: The influence of pressure on the spontaneous ignition of inflammable gas-air mixtures. (4) Methane, ethane and propane-air mixtures. Whereas with the higher paraffins previously reported on, the ignition points were found to lie in two well-defined temperature ranges, location in the higher range occurring at low pressures, and in the lower

range at higher pressures, with methane or the intermediate products to which it gives rise, they were confined to an upper range even at pressures up to 30 atmospheres. The view previously put forward that ignition in the lower system occurs when temperature and pressure conditions favour the survival and further oxidation of aldehydes (mainly acetaldehydes) has found further support.

PARIS

Academy of Sciences, October 28 (*C.R.*, 201, 749–800). FÉLIX MESNIL: The jubilee of the prevention of hydrophobia produced by a bite. Pasteur's first communication to the Academy was on October 26, 1885. Between July 6, 1885 and January 1, 1935, no less than 51,057 persons have been treated in Paris by the Pasteur method, and of these 151, or less than three per thousand, have died of hydrophobia. CHARLES ACHARD and MAURICE PIETTRE: Researches on the proteins of the cancer cell. The albumin isolated from cancerous tissue has the same composition as serum albumin, but has smaller molecules than the latter. PIERRE LEJAY: A new gravimetric linking of European stations of reference. The establishment of a base at the Pic du Midi Observatory. Details of measurements of the acceleration of gravity (g) at eleven European stations, with the same pair of pendulums. PIERRE LEJAY was elected *Correspondant* for the Section of Geography and Navigation. FRÉDÉRIC MARTY: The structure of the rational fractions and autoprojections of topological coverings. JEAN LE ROUX: The idea of distance. M. PAUL VINCENSINI: Convex bodies admitting a given vectorial domain. PAUL MENTRÉ: Developable inflectional surfaces of complexes of right lines. D. TOIDZÉ: Integral functions. LUCIEN CHADENSON: The representation of a group of operators in Hilbert space. JEAN THOUVENIN: The application of photoelasticity to the study of shocks. An application of the Ségum-Labarthe ultra-cinematograph taking 4,000 photographs a second. Four of the films obtained are reproduced. E. BARRILLON and CH. CHARTIER: The flow in the mass of a fluid round an obstacle in the form of a house resting on the ground. An experimental study, the results of which are shown in three diagrams. F. ROCHEFORT and JEAN VILLEY: A new type of aviation motor. A method of pulverising fuels such as gas oil, giving homogeneous mixtures. The method has been applied successfully to a 200 horse-power six cylinder aviation motor. BERNARD KWAL: The difficulty concerning the existence of the infinite energy of radiation at the absolute zero in quantic electrodynamics. PIERRE JACQUINOT and TSAI BELLING: Measurements of the Paschen-Back effect with the Bellevue electromagnet fitted with supplementary coils. With the additional coils the magnetic field was raised to 65,800 gauss. The line 5789–90 showed a considerable Paschen-Back effect: the displacement of the central component was nearly 0·2 A. and the separation of the violet component reached 0·29 A. E. VELLINGER and J. D. HERRENSCHMIDT: The critical temperature of solution of mineral oils. An application of the method of Chavannes and Simon to the study of the changes brought about in mineral oils by refining. ANDRÉ KLING and MAURICE ROUILLY: Some derivatives given by the action of phosgene, methyl chloroformate, mono-, di- and trichlormethyl chloroformates on cholesterol. ANDRÉ DEMAY: The Carboniferous age of the Guéret granite and on the facies of contact metamorphism of the Dinantian grits and tufas of the Puy-de-Dôme and of Creuse. DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: Measurement of the reduced thickness of atmospheric ozone during the polar winter. The authors have developed a spectroscopic method making use of stellar spectra for determining the ozone, and give the results obtained at Abisko (lat. 68° 20′ N.). PIERRE MARTENS: Direct fertilisation and cross-fertilisation in *Parnassia palustris*. PIERRE LESAGE: Acquired and inherited precocity at Rennes and Algiers in 1935. TONY BALLU: The determination of the resistance of a soil to the passage of agricultural tools. DAVID BROUN and H. SCHEINER: The physico-chemical state of the adrenaline hormone in the blood. MLLE. LAÏA OLSZYCKA: The quantitative study of the phenomena of synergy. The potentialisation of the hypnotic action in the mouse. ANATOLE ROGOZINSKI and BARUCH SAMUEL LEVIN: The action and hæmolytic dose of the X-rays.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 3, 1935). I. VINOGRADOV: Fractional terms of polynomials and of other functions. N. SLIOZKIN: Streamlining a gas-filled envelope by a flat stream of ideal fluid. M. MARKOV: Permutations in a vector model of an atom. J. MENDELEJEV: The abnormal density of water in the depths of Lake Baikal. A. RABINOVITSCH, P. VASILJEV and T. GATOVSKAJA: The Donnan effect in ultra-filtration of colloidal solutions. A. PARSCHIN: Influence of paraphenyldiamine on the chemical processes in striped muscles. V. SILBERMINTZ: Occurrence of vanadium in fossil coals. E. KORIDALIN and S. MASARSKIJ: Seismographic prospecting by the method of reflected waves. I. KOROBKOV: The presence in southern Daghestan of strata analogous to the Priabona strata. A. KOLMOGOROV: Deviations from Hardy's formula in partial isolation. P. NIKITIN: The Miocene seed flora near the town of Tomsk, Siberia. A. SEVERCOV: Recapitulation: morphological and histological. A. BOIKO: Septicæmia of bees and its causative agent.

MELBOURNE

Royal Society of Victoria, October 10. B. J. GRIEVE: (1) The brown rot disease of potatoes in Victoria—the bacterial organism responsible for 'brown rot' or 'sore eye' of potatoes in Victoria is described and identified as a strain of *Bacterium solanacearum*, Smith. The reasons for regarding the organism isolated as a strain are as follows: (*a*) there is little or no production of a brown water-soluble pigment in colonies on agar plates; (*b*) there is a slight production of acid in glucose; (*c*) no infection can be obtained when the organism is cross inoculated to tobacco. Earlier reports on the occurrence of the disease and on the organism concerned in Australia are critically discussed. (2) Occurrence of *Bacillus carotovorus*, Jones, causing a soft rot of *Iris germanica* in Victoria. An organism was isolated and its pathogenicity established. Cultural and physiological characters of the organism were found to agree essentially with those of *Bacillus carotovorous*, Jones. The three differences recorded in physiological reactions, namely, non-liquefaction of gelatine, failure to produce indol and absence of definite diastatic reaction, are within the accepted variation of *Bacillus carotovorus*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, December 2

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. Ethelwynn Trewavas: "Oceanic Fishes".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—E. Shipton: "The Mount Everest Reconnaissance, 1935".

Tuesday, December 3

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. W. Wilson: "Indeterminacy in the Physical World".*

CHADWICK PUBLIC LECTURE, at 8.15.—(in Inner Temple Hall, E.C.4).—Dr. R. C. Maxwell: "Town Planning and the Housing Act".*

Wednesday, December 4

WARBURG INSTITUTE, at 5.30.—Dr. A. Mawer: "The Position of Place-names in Linguistic Studies" (succeeding lectures on December 11 and 13).*

ROYAL SOCIETY OF ARTS, at 8.—Prof. G. T. R. Hill: "Travel in the Stratosphere".

Thursday, December 5

QUEEN MARY COLLEGE, at 5.30.—Prof. H. H. Read: "The North-West Highlands of Scotland".*

Friday, December 6

PHYSICAL SOCIETY, at 5.—(at the Imperial College of Science and Technology).—Prof. Charles Fabry: "Vision in Optical Instruments" (Thomas Young Oration).

BROWN INSTITUTION (UNIVERSITY OF LONDON), at 5.30.—(at the London School of Hygiene and Tropical Medicine, W.C.1).—Prof. F. W. Twort: "Modern Views on the Bacteriolytic Agents and their Relation to Viruses" (succeeding lectures on December 9, 10, 11 and 12).*

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE), at 6.30.—Prof. J. E. Lennard-Jones: "Modern Theories of Valency". (Bedson Lecture.)

GEOLOGISTS' ASSOCIATION, at 7.30.—W. P. D. Stebbing: "From the Vaal to the Albert Nyanza · a Sketch of the Physiography and Geology along the Line of the Country Traversed".

Saturday, December 7

ROYAL INSTITUTION, at 3.—R. L. Hobson: "Chinese Porcelain".

GILBERT WHITE FELLOWSHIP, at 3.—(at the Art-Workers' Guild, 6 Queen Square, Southampton Row, W.C.).—Prof. F. E. Weiss: "A Visit to the Big Trees of Canada and California" (Presidential Address).

BRITISH INSTITUTE OF RADIOLOGY, December 5–6.—Annual Congress to be held in the Central Hall, Westminster, S.W.1.

December 5.—Dr. C. W. C. Kaye: "Forty Years of Radiology (1895–1935): A Review and Some Reminiscences" (Silvanus Thompson Memorial Lecture).

December 6.—Dr. G. Harrison Orton: "Calcium Changes and their Importance in Diagnostic Radiology" (Mackenzie Davidson Memorial Lecture).

Official Publications Received

Great Britain and Ireland

London School of Hygiene and Tropical Medicine (University of London), incorporating the Ross Institute Eleventh Annual Report to the Court of Governors, 1934–35. Pp. 16. Report by the Dean on the Work of the School for the Year ended 31 July 1935 Pp. 63. (London. London School of Hygiene and Tropical Medicine.) [611

British Museum (Natural History). Set E 57 · British Immigrant Butterflies and Moths. Pp. 10+5 plates. (London · British Museum (Natural History).) 9*d*. [611

An Economic Survey of the Colonial Empire (1933) Issued by the Colonial Office. Pp. vi+578 (London: H.M. Stationery Office.) 25*s*. net [711

Association of Special Libraries and Information Bureaux. Aslib Book-List · Quarterly Recommendations of recently published Scientific and Technical Books. Vol 1, No. 1, October. Pp. 24 (London · Association of Special Libraries and Information Bureaux.) Free to Members; 10*s*. 6*d*. per annum to non-Members. [711

Department of Scientific and Industrial Research. Forest Products Research Records, No. 4 (Seasoning Series, No 1) Timber Seasoning. By R. G. Bateson. Pp. ii+15. (London. H M. Stationery Office.) 6*d*. net. [811

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Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3449 SATURDAY, DECEMBER 7, 1935 Vol. 136

Humanistic Science

IN recent years increasing recognition has been given to the contacts of science with social problems and public affairs. Many scientific workers, particularly those of the younger generation, are no longer content to be regarded as hewers of wood and drawers of water whose special knowledge is considered to disqualify them for administrative posts. They know how science enters into every department of national life or international undertaking, and they claim to be entrusted with a reasonable share of responsible control of the forces created by them. At present these new powers seem to be out of hand in their effects upon production and also their applications to destruction. Such disappointing results are not, however, essential consequences of scientific progress, but are due to the much slower rate of advance of man's ethical and spiritual nature.

During the past few years, several leading men of science have dealt with these aspects of modern life, and over and over again we have stressed in these columns the duty of scientific workers to assist in securing intelligent recognition of scientific values in civilised communities. During the five years of his presidency of the Royal Society, and particularly in his presidential address to the British Association in 1933, Sir Frederick Gowland Hopkins has on a number of occasions referred to this wider outlook of science, in which responsibilities as citizens are combined with the pursuit of natural knowledge. In his valedictory address to the Royal Society on November 30, extracts from which appear elsewhere in this issue, he deals with the subject again, and supplements the general theme by very appropriately describing the benefits to humanity of scientific investigations of nutrition and food production.

Sir Frederick Hopkins points out that "The current interest in the subject of the national food supply and in right feeding is doubtless largely due to the awakening of the public conscience to this and other kindred social responsibilities; but it has also been stimulated, I think, by the nature of the results which scientific studies during the last twenty years have revealed". In this department of science, at any rate, and in the control and conquest of disease, the knowledge gained has been of unqualified benefit to humanity. Whatever may be thought of modern progress, and however much some people may look back with longing eyes to the days when disease, born in filth and ignorance, stalked through the land practically unchecked, they must acknowledge that science has provided the means of reducing suffering and death due to disease, and of improving our social heritage.

This mastery over the powers—mostly microscopic—which continually tend to destroy mankind, has been obtained by scientific inquiry, the spirit of which has had a greater influence than is commonly understood. As Sir Frederick Hopkins said in his address, "History itself shows that it is wrong to deny ethical influence, even if it be indirect, to the scientific spirit. While, for example, the earlier stages of the Renaissance enriched men's minds by restoring to them the literary and philosophical heritage of antiquity, we all know that not until later, when the awakening scientific spirit demanded a courageous inquiry into the actual facts of Nature, did human thought begin its release from the shackles of authority and traditional dogma."

The intellectual expansion brought about by the workings of this spirit, together with the sense of justice which resulted from knowledge of the existence and permanence of law in Nature, profoundly influenced human thought, and resulted in social changes which had the widest civilising effects. In spite of these ethical aspects, there are some who still regard the humanities as belonging essentially to polite scholarship or classical learning and having an antipathetic relation to science. When Greek was introduced into the curriculum of schools with the Renaissance movement of the fifteenth century, it was because the scholars of that period were eager for the new light which the language could reveal. Humanism then meant the substitution of new teaching for old, and its followers aimed at moulding the nature of man as a citizen and an active member of the State rather than at continuing the studies of doctrines relating to the next world upon which the attention of teachers had been concentrated for a thousand years.

The foundation of the Royal Society in the seventeenth century was a natural development of the revolt against scholasticism and theological authority which had for ages discouraged independent thought. The spirit of the new movement is represented by the Horatian motto, *Nullius in verba*, chosen by Evelyn for the Society and signifying "not bound by the words of any man"; and this intention, as the Earl of Athlone remarked at the anniversary dinner on November 30, was expressed by an even older motto: "Prove all things; hold fast that which is good". The object of the Society was the promotion of natural knowledge through observation and experiment as distinct from supernatural knowledge obtained through revelation. This new experimental philosophy was the method of inquiry which distinguished humanism of that epoch from medieval obscurantism, and its introduction was typical of progressive thought and action just as science is the humanism of to-day.

Science has not only emancipated human thought from the bondage of traditional authority, but also, through the concept of evolution onward and upward, has provided mankind with a new philosophy of life. It embodies, as Huxley pointed out long ago, the evolution of social ethics, and in this development through the right use of knowledge, scientific workers should take an effective part in shaping human destiny.

Culture and Peoples of Ireland

Prehistoric Man in Ireland

By Cecil P. Martin. Pp. xi+184+11 plates. (London: Macmillan and Co., Ltd., 1935.) 21*s*. net.

ALL who occupy themselves seriously with the baffling problems of prehistoric Ireland will welcome this book with open arms. It is just what they have been longing for, ever since science undertook to dispel the accumulated rubbish of charlatanism. It is not Dr. Martin's fault that the first reading of his work induces a slight sense of disappointment: it is because, with all the energy and industry which he has brought to bear upon his undertaking, the actual amount of material which he has found available is comparatively small. But he has made the best possible use of it, and has been enabled to lay a foundation which, with a little underpinning to be supplied by future discoveries, will bear the weight of years of research to come.

Ireland occupies a singular position among the countries of Europe. The Romans left her alone; they saw no advantage to be gained by occupying an island inhabited, as rightly or wrongly they believed, by cannibalistic savages. The country thus escaped Latinisation, and it afforded an extra-imperial refuge first for druids, and later for Christians, driven from their homes by persecution. The former introduced a literary tradition; the latter introduced a religion. But except for early invaders, tempted by the reputation of the auriferous gravels of the Wicklow rivers, and these refugees, the country stood aside, as the stream of culture flowed on elsewhere in the Continent. There is a biological 'lag' in the country, as is well known to biologists: these conditions produced a similar cultural lag, expressing itself in a self-centred absorption in domestic affairs, and an exaggerated appreciation of their importance. In the literature, developed first by druid refugees and afterwards by Christian scribes and teachers, there was enshrined a mass of contradictory legends, of very varying dates, about mysterious peoples called Nemedians, Fir Bolg, and so on, who had successively occupied the country:

notwithstanding which, these legends were overlaid with the boast that Ireland was the typical Celtic country, which had maintained Celtic blood, traditions and culture, undefiled and uncontaminated. This is the notion held by the layman even yet.

But archæologists are digging, palæobotanists are making an intensive study of peat-bog pollenation, 'higher critics' are riddling the documents which report these ancient fables, and Dr. Martin is applying his callipers to every ancient skull, recorded or unrecorded, that he can find in the country; and whether the layman likes it or not, he must awake, sooner or later, from his dreams, to a world of unpicturesque realities.

Preliminary chapters tell, clearly and succinctly, of chronological and craniological methods in modern research; and then the author gets to business. He begins with a few modern skulls, from five different districts in the country, which show, so far as they go, that the proportion of long-headedness increases as we proceed westward. Dr. Martin recognises environmental, as well as racial, causes as operating to produce this result. Next he gives us a brief résumé of early research in Irish ethnology, and of the endeavours made by Wilde and others to correlate the evidence of craniology, so far as it was understood in their time, with the invasion-traditions referred to above. Then comes a most valuable series of chapters, describing the craniological material from successive stages of Irish history—from the caves, the 25-ft. raised beach, the megalithic monuments, the later Bronze Age, the Iron Age, the Crannogs, the Early Christian period, and the time of the Norse invaders. In the first of these chapters, the author is not inclined to reject summarily, on the ground of more recent research, the authenticity of the Kilgreany man (or rather woman) as a true cave-dweller. The evidence from the raised beach and the later sandhill settlements is of the scantiest; but, such as it is, it points to a race "of low stature, with very long, narrow, and high skulls".

The Megalithic people seem to be variants of the same stock, but not necessarily direct descendants of their shore-dwelling predecessors; but the later Bronze Age introduces us to a definitely distinct race, thereby confirming the testimony which archæology has been voicing with a growing insistence, to the effect that there was an abrupt interruption in cultural development about the middle of the Bronze Age. Unfortunately, the critical problems relating to the introduction of the Iron culture are not yet illuminated by osteological material; but certainly the later evidence shows that in early Christian times races were as inextricably mixed in Ireland as they are to-day. One by one the shadows of the 'Celtic twilight' are vanishing, in the cold clear light of common day.

The book is well printed, and excellently illustrated. There are a number of misprints here and there in the text which it might be well to correct in a later edition; but these trifles apart, we have nothing but praise for the book and gratitude for its author.

Band-Spectra and Molecular Structure

The Optical Basis of the Theory of Valency By Dr. R. de L. Kronig. (Cambridge Series of Physical Chemistry.) Pp. x+246. (Cambridge: At the University Press, 1935.) 16*s*. net.

THIS book is highly recommended to those interested in the determination of molecular structure by physical methods. Here a wide range of material will be found presented in a simple but authoritative manner. A noticeable feature is that each chapter is practically complete in itself; and this makes the book very readable.

The first chapter is short, and serves as introduction. The second explains how the size and shape of molecules can be determined from experiments on the scattering of X-rays and electrons. It is unfortunate that the very recent work of Brockway and Sutton on the diffraction of electrons by the chloro-methanes appeared too late to be included in this chapter. Apparently only departures of the order of a degree or two can occur from the tetrahedral angle, in contrast with earlier conclusions based on X-ray evidence that they could be of the order ten degrees. The third chapter gives the usual account of the Periodic system, but has in addition a useful section on the charge, electron configuration and the size of ions. The fourth and fifth chapters are very good. They are the central portions of the book and represent the happy medium between an elaborate treatise on band-spectra and the few pages that are often considered sufficient for the subject. In them an account is given of the determination of molecular structure from band-spectra in the visible and infra-red regions of the spectrum. The significance of normal modes and force constants

is clearly explained and illustrated by numerous examples. The sixth and last chapter is also practically complete in itself, and deals with optical and thermal dissociation of molecules. This chapter is the lazy man's ideal, for it is so well illustrated with diagrams that there is scarcely any need to read the text.

Two minor criticisms may be levelled against the book, but of these perhaps the second is merely a prejudice on the part of the reviewer. The first concerns the title. One is not quite sure what to expect from "The Optical Basis of the Theory of Valency", but surely it is reasonable to hope for more than a very occasional reference to valency. The difficulty is of course appreciated. Obviously the best title is "Band-spectra and Molecular Structure", but unluckily this has already been used by Dr. Kronig for his earlier book. However, since more than half the book is covered by chapters beginning "Band-spectra and Chemical Binding", this itself would not have made a bad title. Our second criticism is that we consider a separate chapter should have been given to theories of valency based on quantum mechanics. Certainly, these are no appendages to normal modes and band-spectra of polyatomic molecules, as they would appear from the book. We would have liked a fuller explanation of the Slater-Pauling theory of directed valency, and to have heard something of Mulliken's bonding, anti-bonding and non-bonding electrons.

This is one of the easier books to read, but it contains a great deal of information that is not easily digested. The style is clear and very much to the point, and the reader is carried swiftly but safely over many waters and through many rapids. As one now expects in any book by Dr. Kronig, the bibliography is most complete and the index good. There are half a dozen excellent plates and numerous well-drawn figures. W. G. P.

Faith and Fact

Science and the Supernatural

A Correspondence between Arnold Lunn and Prof. J. B. S. Haldane. Pp. vii+412. (London: Eyre and Spottiswoode, Ltd., 1935.) 10*s*. 6*d*. net.

THE method of controversy by correspondence has this advantage, when the correspondence is published in book form, that there is something very entertaining for the reader, who is in the happy position of a person watching a fencing bout or a game of billiards. But what such a book gains in entertainment value it may lose in other directions; it may, for example, be so discursive in method that it gets nowhere—or at least not nearly so far as the reader thinks he has a right to expect. Such indeed is the failing of the very interesting volume before us, wherein Mr. Arnold Lunn and Prof. J. B. S. Haldane engage in conflict for our edification.

The discursiveness, it is to be feared, is to be attributed very largely to the challenger—Mr. Lunn—who conveys the impression (like a bad chess-player) of not having laid his plans, with the result that the argument wanders like a lost child. For example, as early as p. 30, he makes the challenging and important statement that "We can prove that God exists by pure reason without entering a laboratory or consulting modern astronomers". In other words, he says (it is the beginning of all orthodox apologetic) that there are convincing metaphysical arguments for the existence of God. This is an important point if you are arguing about science and the supernatural. But having opened so well, Mr. Lunn does not proceed along these lines. On the contrary, he has to be urged repeatedly by his opponent to expound these metaphysical proofs. In the end, it is Prof. Haldane who, on p. 169, outlines the proofs and proceeds to examine them himself; and it is not until seven months and several other letters have passed that Mr. Lunn, now on p. 254, proceeds to answer Prof. Haldane's criticisms.

Turning towards the end of the book (p. 352), we find Mr. Lunn's explanation of this apparent reluctance to come to close quarters:

"You introduced St. Thomas's metaphysical arguments, but apart from this digression I have made no attempt to develop the traditional arguments in defence of Christian theism, for I do not think we have yet reached that stage in the debate in which it is profitable to pass from a discussion of the existence to a discussion of the nature of God."

This looks like a belated justification of the course which the argument has taken, composed after the event. Prof. Haldane's examination of Aquinas's arguments would scarcely have been introduced had not the question of the metaphysical proofs of God's existence been already raised by Mr. Lunn himself at the outset. To term it a "digression" seems strange.

In this same examination of the course of the argument, Mr. Lunn observes that the

correspondence started "by debating whether the Christian approach to truth was more scientific, or, as you think, less scientific than your own approach". This also was a very important question, but is best discussed not, as Mr. Lunn discusses it, by accusing scientific men of scepticism and intolerance, but by making a serious examination of scientific method, inquiring how its 'abstractness' hinders contact with reality, and whether it can deliver qualitative, as contrasted with quantitative, judgments. All this is legitimate material for discussion, and is really of much more importance than the alleged shortcomings of scientific workers, who do not claim to be any less human than theologians.

A great deal of attention is devoted by Mr. Lunn to what he terms the "physical" (as contrasted with the "metaphysical") proofs of the existence of God. This involves an attack on Darwinism, since this tends to make life self-explanatory, and also an examination of the 'miraculous' cures of Lourdes and the results of psychical research. The attack on Darwinism, based largely on the theories of Berg, elicits what appear to be some convincing rejoinders from Prof. Haldane, who asserts that we can no more go behind Darwin in biology than we can behind Dalton in physics and chemistry, or Harvey in physiology—though this, of course, does not involve the last word having been said in any of those spheres by any of the authorities named. As for Lourdes, Prof. Haldane is not satisfied of the miraculousness of any of the cures, real or alleged. There is the question of diagnosis, of the habit of skin diseases of clearing up rapidly, of the results of hypnosis, and so on. It is in fact impossible to say that a cause lies outside Nature until the whole of Nature has been explored.

After all, as Prof. Haldane points out, evolution is a minor question, and not worth the amount of space devoted to it here to the exclusion of more important topics such as "how a perfectly good and almighty creator could have made a world containing so much evil". It is a pity that Mr. Lunn definitely declined to tackle that question on the ground that there was now no space—the space having been squandered by himself on comparative trivialities and irrelevances.

"Our standards of intellectual valuation are so different", writes Prof. Haldane at the end, "that we found it hard to get to grips". The trouble is that the two disputants are not equally matched. Mr. Arnold Lunn, though a clever controversialist, is not in the religious sphere the equivalent of Prof. Haldane in the scientific sphere.

J. C. HARDWICK.

Natural Philosophy in the Ninth Century

Encyclopædia of Philosophical and Natural Sciences as taught in Baghdad about A.D. 817, or Book of Treasures

By Job of Edessa. Syriac Text edited and translated with a Critical Apparatus by A. Mingana. (Vol. 1 of Woodbrooke Scientific Publications.) Pp. xlviii+470. (Cambridge: W. Heffer and Sons, Ltd., 1935.) 42*s*. net.

JOB of Edessa, "Job the Spotted", or Ayyūb ar-Ruhāwī, was born in Edessa, possibly about A.D. 760, and seems to have survived until about A.D. 835. He was a member of the Nestorian church, and has achieved fame as one of the earliest and most prolific translators of Aristotle and Galen into an oriental language. Besides translations, he wrote many original works, of which only two are extant, namely, a treatise on canine hydrophobia, and the "Book of Treasures" which Dr. Mingana has here edited and translated from a manuscript —the sole copy in a European library—in his own collection. The "Book of Treasures", probably written about A.D. 817, is a kind of philosophical and scientific encyclopædia; it affords a clear perspective of the intellectual background of Bagdad under Hārūn ar-Rashīd and Al-Ma'mūn, and shows that, while Aristotle and other Greek writers were regarded as the great masters of secular knowledge, independence of thought was more prevalent than might be expected.

The scope of the book is wide; it includes metaphysics, theology, psychology, biology, anatomy, physiology, medicine, chemistry, physics, music, mathematics and astronomy. Among points of special interest are Job's rejection of astrology, his development of the idea of the elemental origin of the universe and of the different bodies comprising it, his denial of a material hell, and his explanation of the cipher—an arithmetical sign which reached Bagdad during his lifetime. The cipher, according to Job, is a circular link between number nine and number one, causing numbering in general to proceed in a succession of cycles between one and nine; the figure of the cipher is a circle made by linking the forefinger and the thumb together, and its

very shape represents the 'emptiness' of its unattached value.

In general, the book conveys the impression that its author was a man of vigorous and balanced mind, though, like the vast majority of his contemporaries, he shows astonishing credulity in many directions, and is anxious to leave nothing unexplained. Thus, he says that the functional ground for the non-existence of hair on the human forehead and cheek-bones "is to prevent dust, sand and other things which happen to fall on those places, from getting a footing there, and thus impeding vision"; further asserting that animals walk on all fours because, if their posture were upright, they could not be of much use as beasts of burden. On the other hand, he correctly explains the appearance of the Milky Way, and has a reasonable, even though incorrect, hypothesis to account for the salinity of sea-water.

Whether right or wrong, however, credulous or sceptical, Job is always interesting and lively, and his treatise is worth the attention of both the general reader and the historian of science. Dr. Mingana is to be thanked for having rendered it accessible, and for the valuable notes and commentaries which he has added. Unfortunately, there is no index, though the want is partly supplied by a fairly full table of contents.

E. J. HOLMYARD.

Experimental Botany

Botany as an Experimental Science in Laboratory and Garden
By Dr. Lilian J. Clarke. Pp. xvi+138+9 plates. (London: Oxford University Press, 1935.) 6*s*. net.

LILIAN J. CLARKE entered on her career as science mistress at James Allen's Girls' School, Dulwich, in 1896, at a time when science was still the Cinderella of the curriculum; long before her retirement in 1926 she had raised its status to such a degree that much of the renown of the school was based upon the results of its teaching of science. At the outset there was no laboratory, no apparatus, no available ground, no money. Within five years, however, a small general laboratory had been built, a few order beds established in the school gardens, while the pupils were already taking the highest places in botanical examinations in competition with other schools in London and elsewhere.

The earliest teaching was on more or less orthodox lines, and matriculation candidates spent much time on elaborate section cutting and work with the compound microscope. Gradually this was all changed, and individual experimental work became the objective for each pupil. Increasing stress was laid upon plant physiology, every step being elucidated by experimental work, usually of the most simple character. Plant nutrition was studied by means of water cultures, with such success that many generations of a single species were grown over periods of years, in spite of untold difficulties arising from the shortness of school terms.

Eventually more adequate accommodation was provided in the form of a science block with separate laboratories for botany and other branches of science. At the same time the development of the botany gardens proceeded steadily. For years no grant was forthcoming, all the plants being provided by the girls and mistresses and all the work done voluntarily by the girls in their spare time. At last, by dint of sheer enthusiasm and persistence on the part of Dr. Clarke, the value of the gardens for teaching purposes was recognised and an annual grant, which is still continued, was given by the Board of Education. The upkeep of the gardens is still by voluntary work, and the layout of the lawn, wood, ponds, sand dune, heath and other sections is such as to beautify the grounds as well as providing invaluable training in many aspects of botany.

The record of thirty years' struggle and progress has been written by Dr. Clarke, who completed the text, but did not live to see it through the press. She has given accounts of the many experiments with the details of technique which are apparently so insignificant, but which make or mar the success of the work. A great feature is made of the recording and comparison of results year after year, which has provided an accumulation of valuable data of which it has only been possible to give some indication. The book should prove a mine of information for teachers, and can equally well be used by the students themselves, as it is full of ideas and suggestions which stimulate the imagination and encourage independent investigation. As a textbook it is unique, and as a record of progress perhaps only those who were among Dr. Clarke's earliest pupils can appreciate fully the greatness of the achievement.

W. E. B.

A Text-Book of Organic Chemistry: Historical, Structural and Economic

By Prof. John Read. (Bell's Natural Science Series Second edition. Pp. xiv+703. (London: G. Bell and Sons, Ltd., 1935.) 12*s*. 6*d*. net.

PROF. READ'S textbook differs from many others on organic chemistry by its insistence on the importance of a knowledge of the early development of the subject, so that the student is enabled to follow the growth of the science from very ancient days to the present time. The theme has been presented in most attractive fashion by including in the text quotations of famous passages from documents of historical interest. Thus the problems, which were faced successively by Wohler, Liebig, Kekulé, Pasteur, le Bel and van 't Hoff are set vividly before the reader. The rapidity with which chemical theory has been developed is most strikingly illustrated by a footnote on p. 276 from which we learn that Chevreul, who was born before the theory of phlogiston was abandoned, survived into the era of the asymmetric atom, the ionic hypothesis and synthetic indigo.

The historical aspect of the subject, however, has been by no means overstressed. The author has kept in mind not only the academic but also the industrial and economic interest, whilst biochemical discoveries have also received attention. Thus the chapter on carbohydrates includes an account of the economic aspect of sugar manufacture and a summary of the main features of interest in connexion with the various cellulose industries. The author does not discuss the actual structure of starch and cellulose, although a formula is given for the starch unit. It is rather surprising to find that the pyranose ring formulæ, which are so helpful to the student of stereochemistry, have not been adopted. Indeed, the chapter on stereochemistry might well have been expanded to include an account of some of the numerous types of molecular dissymmetry which are not associated with the asymmetric atom.

Turning to the polycyclic and heterocyclic compounds, we find useful summaries of the properties and composition of explosives, dyestuffs, drugs, perfumes, photographic chemicals and alkaloids, while a new chapter deals with the hormones and vitamins and another with the electronic theory of valency. The book provides a useful introduction to the subject, and should help the beginner to realise not only the practical value of certain organic products but also the important contribution which the organic chemist has made to the building up of chemical theory.

Paläohistologie der Pflanze:

Grundzuge einer Gewebelehre über fossile Pflanzen. Von Dr. Elise Hofmann. Pp. vii+308. (Wien und Berlin: Julius Springer, 1934.) 25.20 gold marks.

THE author presents a brief review of the anatomical structure of fossil plants, with a concluding section surveying the history of their various tissues and cell types. The descriptions are illustrated by numerous figures, some of which are original. Certain topics, such as the structure of fossil cuticles, receive fuller consideration than in any earlier book of the same character, but other subjects, such as the structure of the elements described by palæobotanists as phloem, receive a rather superficial treatment. In several sections the author seems to have taken all her information from recent papers, to the neglect of older work in which more complete descriptions are to be found; but she gives references to all the more important papers.

The value of the work is difficult to estimate. It will probably be of considerable use to Continental students, who have often underestimated the value of anatomical work in relation to morphology and taxonomy. When compared with the English works which deal with the structure of fossil plants, it often seems rather poor, but on the other hand it covers a wide field and gives an adequate introduction to some of the modern aspects of palæobotanical research. It is not entirely free from mistakes, both in the naming of the specimens figured and in the text.

Erdöl-Muttersubstanz:

Beitrage zu dieser Frage. Von Dr. F. E. Hecht, Prof. Dr. K. Krejci-Graf, Prof. Dr. R. Potonié, Prof. Dr. H. Steinbrecher, Dr. A. Treibs, Dr. E. Wasmund, Dr. Dora Wolansky. (Schriften aus dem Gebiet der Brennstoff-Geologie, herausgegeben von Prof. Dr. Otto Stutzer, Heft 10.) Pp. vi+181. (Stuttgart: Ferdinand Enke, 1935.) 17 gold marks.

A VALUABLE collection of essays on the vexed question of petroleum origin has recently been made available through the good offices of Prof. Otto Stutzer. The collection includes articles by well-known chemists, geologists and hydrologists. Dr. Erich Wasmund gives his opinion as to the origin of adipocere ('corpse wax') and also advances the theory that anærobic anabitumen bacteria can also originate in bitumen. Dr. Karl Krejci-Graf discusses the varied theories of origin of bituminous sediment, and projects interesting and novel conclusions for the attention of the reader. Dr. Hecht traces the chemical history of organic substance in the sea from the moment of death until final fossilisation and entombment. Dr. Treibs first reviews the works of J. E. Hackford and E. Berl on the transformation of plant substance, especially carbohydrates into oil, and then in his contentions that porphyrines are contained in petroleum derived from chlorophyll and hæmin, and that a higher formation temperature than 200°C. is out of the question for petroleum, shows that he differs from both. Prof. R. Potonié reports the results of geochemical investigations of sapropel from the Unterrucker Lake near Prenzlau and the Sakrower Lake near Potsdam. Prof. Steinbrecher emphasises the chemists' proved point of view that petroleum normally found in oilfields is not high temperature petroleum, since it contains constituents which would decompose at high temperatures. Finally, Dr. Dora Wolansky summarises such views as have appeared in Russian literature on petroleum origin, thereby giving a synopsis of valuable ideas which in their original form are incomprehensible or inaccessible to the majority of people.

Electricity in Poultry Farming

By C. A. Cameron Brown. Pp. 73+12 plates. (Oxford: Institute for Research in Agricultural Engineering, 1935.) 2*s*.

EVERYONE who is interested in poultry farming should read this book. It is written to help the average farm worked by its owner. The author has not in view the large 'luxury farm', worked sometimes altogether by electricity, the true economic value of which it is difficult to estimate. In this book the facts relating to the use of electricity on poultry farms in many different parts of the country are given, together with the work done by research institutes. Lancashire and Yorkshire are very favourably situated, since farmers can buy electricity at ½–1*d*. per unit. In districts where the cost is 1½*d*. the user has to be economical in its use. All those consulted agree that there is a distinct saving in labour, a gain in cleanliness, safety from fire and exactness of operation by using electricity.

The economies that might be effected by relieving the hen from hatching eggs and brooding chicks and keeping it to its irreplaceable duty of laying eggs has been recognised from the earliest times, particularly by the Egyptians and Chinese. The author describes many types of incubators and gives the relative prices of hot-air machines when worked with oil and with electricity. He states that there is now no question about the technical success of electrical methods in poultry farming. Preston Corporation supplies 300 poultry farms with electricity, the average consumption of each being 7,000 units, and rapid developments are taking place in other areas.

Introduction to Electric Transients

By Prof. B. Kurtz and Prof. G. F. Corcoran. Pp. xv+335. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 22*s*. 6*d*. net.

As an introduction to the study of the curious effects produced initially when the switch is closed in an electric circuit due to its inductance and capacitance, we can recommend this book. Each type of transient phenomenon is considered from three angles. The student first analyses the problem by means of the principles and laws of physics. It is then discussed mathematically, and this usually involves solving a differential equation. Finally, the solution is illustrated by actual oscillograms. This experimental verification of sometimes quite unexpected mathematical results will greatly encourage the student and show him that theory is sometimes a great help in practical work.

In addition to showing voltage and current waves, power waves and sound waves obtained experimentally are given. The electrical records of three different tones obtained from the same instrument are very instructive. In this case the relatively pure tone has a fundamental frequency of 466 cycles a second, while the other two composite tones have frequencies of 173 and 87 cycles respectively. A useful chapter is given on Heaviside's operational calculus.

Elementary Textbook of Chemistry: with Laboratory Experiments

By John J. Guenther. Pp. xiv+274. (New York: The Macmillan Co., 1934.) 7*s*. 6*d*. net.

THE contents of this book are quite unlike anything a reader would be led to expect from the indication of the title, as ordinarily understood in Great Britain. The preface explains that the volume is designed mainly to meet the needs of schools of nursing, and the curriculum of these, as required in the United States, and to provide a course for presentation in "45 hours of time". The ground covered ranges from basic definitions in chemistry and physics, over elementary theory, formulæ, equations and calculations, and the general chemistry, chiefly of the non-metals, to complex organic substances such as higher fatty acid derivatives, aromatics, carbohydrates and foodstuffs, the organic chemistry occupying roughly one-third of the book. Sufficient attention is given to household, hygienic and everyday applications as to provide, virtually, a treatise on domestic science.

The course is intended to be followed rigidly, in the nature of a drill, and copious lecture and practical experiments are detailed. The amount of matter is remarkable, and might provide material for a year's study. Although the needs of the curriculum might be met, it is difficult to see in what respect the cause of scientific education would be furthered by covering the ground in forty-five hours, the distribution of which is left unspecified. An efficient index covers twenty-four pages. N. M. B.

The Calculus

By Prof. Hans H. Dalaker and Prof. Henry E. Hartig. Third edition. Pp. viii+276. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 12*s*. 6*d*. net.

THE application of the calculus to the problems of engineering and physics has now become so extensive that writers on the subject no longer confine their treatment solely to the purely theoretical side. This is very encouraging, and, in the volume under review, the authors have made a very commendable attempt to combine theory and practice without sacrificing the fundamental principles of the calculus. The course covered is fairly comprehensive. Beginning with the ideas of functionality and limits, the student is led on to differentiation, with its manifold applications; integration up to double and triple integrals; infinite series and expansion; and finally, to a brief outline of differential equations. The principles developed are well illustrated by many fully worked-out problems drawn from mechanics, physics and engineering, and the accompanying diagrams are very clearly produced.

For the student, numerous carefully graded exercises, with answers, are provided both for purposes of drill and in illustration of practical problems. A complete and useful summary of formulæ, curves and integrals is given as a final chapter. The whole text is clearly printed and the book should prove very valuable to the advanced practical student.

Science in Modern Life*

By Sir Frederick Gowland Hopkins, O.M., F.R.S.

SOCIAL RESPONSIBILITIES OF SCIENCE

OWING to what would seem to be a confusion in thought, the supposed social harms created by science have been vaguely attributed in some not unprejudiced quarters to its own unethical character. General Smuts, on the other hand, holds that among the values gradually recognised by the developing human mind, science ranks with religion and art, and that while to-day religion, art and science are separate values, they may not always remain so. Indeed, he thinks that one of the greatest tasks before the human race will be to link up science with ethical values. It is perhaps not quite easy to follow closely his thought concerning the future extension of the scope of science, but his own assurance that its teaching can be linked up with ethical values is a corrective for some of the accusations from which science is apt to suffer.

Indeed, possible future developments apart, the gap between what science provides for humanity and what are usually spoken of as values in religion, literature and art, has been and is less wide than some assume. History itself shows that it is wrong to deny ethical influence, even if it be indirect, to the scientific spirit. While, for example, the earlier stages of the Renaissance enriched men's minds by restoring to them the literary and philosophical heritage of antiquity, we all know that not until later, when the awakening scientific spirit demanded a courageous inquiry into the actual facts of Nature, did human thought begin its release from the shackles of authority and traditional dogma. This release was surely ethical in its effects. In later times, throughout the years of the Royal Society's existence, the growth of intelligent interest in the material universe was slowly preparing the ground for that last great step in the progress of intellectual freedom which came in the middle years of the last century. The influence of Darwin and Lyell did more, of course, than establish a new outlook for science itself. It re-orientated all thought. It caused heart-searchings where there had been mere complacency in the acceptance of tradition, and its impacts subtly encouraged the growth of that intellectual honesty for which Huxley and others then so nobly fought. The history of those days is familiar enough, but we sometimes forget the debt we owe to them.

It was the influence of science which, more than any other influence, established the idea of progress, replacing as it did a static by an evolving universe, and incidentally a faith that man himself has an inherent capacity for advance. There are not a few to-day who profess to disbelieve in progress; but for the majority it is now a faith ingrained if sometimes only subconsciously held. Evolution, we know, may not at each step tend upwards, but we have reason to believe that in the long run it does, and that in spite of occasional disillusions we may believe in the upward tendencies of mankind. By this faith, hope is fed, human efforts towards betterment are encouraged, and ethical values emerge. The depressing belief that man and the social fabric he has contrived for himself, while so imperfect, are yet incapable of ultimate betterment, was the one excuse for that particular form of professed otherworldliness which from time to time has been an essential part of narrow religious ideals, but which was surely evil in its almost contemptuous indifference to social wrongs and to the urgent problems of this world.

The tendency of late, however, has been not so much to reiterate the theme of science's gifts to the powers of destruction, but rather to urge in a more general sense that scientific workers have not shown sufficient interest in the social implications of their work, or in the public responsibilities of their calling. We have only to look closely into this view as usually expressed to realise that, after all, its basis is vague, and, did it involve any charge against the individual worker, unreal. The individual investigator must realise that, *qua* scientist at least, he has little opportunity for effective action. Commonly he concludes that he will be most useful, even to society, by continuing his chosen work in its proper environment.

It is, I think, impossible not to sympathise with this view. The special endowments acquired by the scientific investigator are not those of a politician or of a missionary. Needless to say, it remains his duty to give his skilled services to the public whenever they are legitimately required and invited, and in so giving them he may do much to promote the interests of science itself.

What seems to be really desirable is some method of closing the gap between the mind and outlook of the publicist and those of the trained scientist. It is a just claim that in a civilisation so largely based on science as that of to-day, the scientist

* From the anniversary address to the Royal Society, delivered on November 30, 1935.

should have more influence on policy than he has hitherto been allowed. Not long ago the gap in question was wide; it is now, I think, lessening. Occasionally at least, modern statesmen do seek scientific guidance, and, I think, know better than they did how rightly to obtain it. But it is time, perhaps, that the building of a bridge should begin on the scientific side of the gap. This is a task for organised scientific effort and the pooling of knowledge.

Problems of Nutrition and a National Food Policy

There is a branch of scientific inquiry which can claim to yield knowledge of unqualified benefit to humanity, and one in which investigators, though inspired by the extreme scientific interest of the problems involved, have, I feel, always had the public importance of their solution in view, and have themselves done their best to encourage the practical applications of the knowledge they have won. I refer to the study of the nutritional needs of the body.

The last two decades have seen a quite remarkable activity in research upon nutritional problems, and it is now even increasing. Publications describing original work upon various aspects of these come from almost every country where science is pursued, and have amounted to many hundreds during the course of each single year. In Great Britain much research on nutrition has been generously endowed, organised and encouraged by our Medical Research Council, and it has received financial support from various other sources. We have begun to follow the example of the United States in founding chairs in dietetics, and emphasis is being placed upon the subject in physiological and biochemical teaching in the universities.

A desirable happening at the present moment is the international approach at Geneva for full discussion of the nutritional problems of the world; for, viewed broadly, the problems are undoubtedly international. On a demand from the representatives of twelve nations including Great Britain and Australia (which has played a leading part in the movement), the health organisations of the League have set machinery in motion for securing full and intimate discussion. Policies concerned respectively with the production, transport, distribution and consumption of foods will all, we may hope, be discussed. They seem to be the very proper business of the League, and if discussion goes deep enough and is frank enough, it may well do no small service to the interests of peace itself.

Many are concerned just now to know the truth concerning the degree and extent of malnutrition as it exists among the less fortunate sections of the community at the present time. They have seen certain desirable steps taken to mitigate whatever may exist, as, for example, the diversion of surplus milk to the schools; but they yet ask how far is an extension of such measures an urgent need of the moment. That underfeeding and ill-feeding exist is sure, but to measure their extent is, for reasons to which I will allude, a task of some difficulty.

We have only to read the successive annual reports from numerous medical officers of health to believe that, in the case of children at least, nutrition, inadequate for one reason or another, exists in various districts to an extent which is far indeed from being negligible. Nevertheless, we have to realise that the numerical data supplied from different centres are based upon varying standards, and the opinions expressed depend to no small degree on the temperament and perhaps on the acuity of individual officers. The difficulty before all concerned is that there is no clear definition of the term 'malnutrition', and no satisfactory objective methods for measuring its degrees. Sir George Newman, formerly Chief Medical Officer to the Ministry of Health, always felt justified in taking an optimistic view concerning the available food supply for children in Great Britain, and he was wont to insist upon the circumstance that though under-nourishment may be due in part to an insufficient quantity of food, it depends also on other factors. "The principal cause," he wrote, "is a body unable to assimilate the food supplied to it." In certain cases this must, of course, be true, but we are entitled to ask whether in many such cases the disability of the body when observed has not followed upon malnutrition at an earlier period. What we know to-day justifies this view.

In any event, the essential question is whether food adequate in quantity and quality is within the reach of all. In the annual report for 1934 issued by the present Chief Medical Officer of the Ministry, it is made clear in a section devoted to the effect of unemployment on national health and dealing with evidence based upon a conjoint investigation by officers of the Ministry and the Board of Education into conditions in certain depressed areas in Durham, that the statistics of actual diseases there do not indicate unfavourable effects of present economic conditions. We may conclude from this, and take comfort from the fact, that malnutrition even in such areas has not been at its severest, but it may be highly deleterious in its ultimate effects when not such as to affect the current statistics of disease. Moreover, full normal nutrition was only claimed for some 70–80 per cent of the children, varying between these figures in different areas, and though, as I have

said, criteria for establishing the existence of subnormal nutrition are not satisfactory, it is difficult to be content with such figures. The Ministry's investigators admit further that in the areas studied the condition of adolescent youths, especially those aged 14–15 years, was found unsatisfactory. These are years when good nutrition is quite especially desirable.

As a measure of the state of health of younger adults at the present time, the results of medical examinations for recruiting are not without importance. The War Office report on the health of the Army for 1933 shows that in that year nearly 38 per cent of the prospective recruits were rejected as unfit. Although, as the report points out, many of these rejections were on account of disabilities which unfitted them for military service in particular, and therefore did not reflect on their general health, yet a glance at the stated reasons for rejection shows that a large proportion of the men suffered from defects which might well be due to faulty nutrition in childhood or adolescence, and a considerable proportion in which it almost certainly contributed to their unfitness.

The current interest in the subject of the national food supply and in right feeding is doubtless largely due to the awakening of the public conscience to this and other kindred social responsibilities; but it has also been stimulated, I think, by the nature of the results which scientific studies during the last twenty years have revealed. They have shown that our nutritional needs are so much more numerous, subtle and specific than was earlier thought, and they have shown how extraordinarily potent and how entirely indispensable material may be, even though consumed in infinitesimal amounts. We know now that a fault in quality may be as deleterious as a failure in quantity. This fact the general public is now rapidly assimilating, though not always to its profit. Indeed, a certain vocal section of the public is (as it has always been) so perverse in its views concerning food that it is almost necessary to remind it that, after all, quantity still counts. We cannot live on vitamins alone! A more intelligent section of the public seems, I notice, to assume with impatience that so much scientific talk about food may lead to individuals being dragooned with respect to what they shall or shall not eat. A self-constituted committee whose propaganda against malnutrition I respect for its wisdom and fairness has appreciated this attitude, and in a recent memorandum made the following wise statement: "certain diet habits must be classed as cultural, and of personal and psychological necessity, and to upset these in the service of protein or vitamin content is to provoke a natural reaction against [the advice that science can legitimately give]". It is, of course, unthinkable that there should be any such dragooning. The intelligent public will learn to apply the newer knowledge of nutrition without discomfort to itself.

The same memorandum says—again wisely—"to a working class housewife with restricted purchasing power, education in food values alone can only add one further problem to an already insoluble series of anxieties and worries". This of course is true, and so long as we see that foods of the right variety are all within her purchasing power, elementary instruction in terms of the foods themselves and not in technical food values will set the housewife on the right path. I am tempted to add that what the English housewife in the poorer classes needs most to be taught is the art of simple but good cooking! It is not beneath the dignity of nutritional science or of administrative policy to take note of the circumstance that in Great Britain, more than in perhaps any other country, is good food ruined, and its nutritional value impaired, by unintelligent treatment in the home.

One last consideration. Is the time yet ripe for the initiation of a comprehensive national food policy: one that will endeavour to adjust production, in a qualitative as well as a quantitative sense, to right consumption, and at the same time organise all the details of distribution on national lines?

I note that those responsible for the contents of that very impressive book entitled "The Next Five Years", which has appeared under the ægis of many influential names, hold that no administrative action less comprehensive than a national policy of the kind in question could deal adequately with existing problems. They suggest that it should now be taken in hand. Others have urged that, apart from the almost prohibitive magnitude of effort the policy would require, it is one which should await the arrival of more knowledge. The latter suggestion has, I think, but little point. There is doubtless much more scientific knowledge to be gained about nutrition and food production, but we know enough to guide administration on to the right lines.

More to be thought of perhaps is the fact that if we take a long range view, any policy concerned with food production must ultimately, if it is to be ideal, become part of a world policy. At Geneva, Mr. Bennett, speaking of such a world policy, said that its aim would be to "marry agriculture to health". Such a marriage, if ever properly consummated, would greatly profit the world. The interests of both partners must be equally guarded, however, in the marriage contract. In Great Britain, one may venture to say, the first mentioned is at present receiving preferential treatment.

The Advance of Herring Research

ON April 21, 1881, Prof. T. H. Huxley delivered a striking lecture at Norwich on the herring, during the National Fishery Exhibition held there. Reference to the text of that lecture (published in full in the issue of NATURE of April 28, 1881) shows that Huxley made the following statement: ". . . And all kinds of real knowledge and insight into the facts of nature do so bear upon one another and turn out in strange ways practically helpful, that I propose to pour out my scientific budget, in the hope that something more may come of it than the gratification of intelligent curiosity". Fifty-four years later, in the same city of Norwich, during the recent meeting of the British Association, the members of Section D (Zoology) listened to a symposium on the herring problem which demonstrated beyond any doubt the truth of Huxley's assertion, and realised his hope. Indeed, the symposium can best be described as an account of current investigations for the express purpose of rendering direct assistance to the commercial herring industry, not only by predicting the quantity and quality of the fish likely to be available during an impending season, but also by stating where and when nets should be set in order to secure the best possible catches. That is to say, the 'problem' with which the symposium really dealt was the entirely practical one of how to aid industry by scientific research.

The four papers of the symposium were read by Mr. E. Ford, Dr. W. C. Hodgson, Prof. A. C. Hardy and Mr. R. S. Wimpenny, in the order named. The first paper confirmed and extended Huxley's view that practised eyes distinguish local breeds of herring, dealing in particular with the study of vertebral variation as evidence in this connexion. It was shown that although the simple count of the total number of vertebræ in a herring falls far short of the ideal specification of so important an organ of the body as the backbone, its use as a statistical character in population studies has proved of very material assistance in acquiring knowledge of the life and movements of the different local forms of herring within their own limited territories of the sea. Using the average number of vertebræ for a sample of herrings as a statistical estimate of the average for the population from which the sample was drawn, real population differences have been demonstrated by comparing sample with sample: and by considering the results in conjunction with corresponding differences in other characters, the 'ground-plan', as it were, of the complex of local forms by which the species *Clupea harengus* is represented has gradually revealed itself. The reliability of this work remains unaffected by the fact that scientific opinion is at present divided as to the precise nature of a local form of herring, and the parts played by heredity and environment in preserving its continuity from generation to generation.

Having learned the essential facts in the life-history of the particular local form with which he is concerned, an investigator may then inquire into the factors which determine the success or failure of the commercial fisheries based on that local form. Important researches of this kind in connexion with the great East Anglian drift-net fishery in the Southern North Sea formed the subject of the second paper in the symposium. The sharp and irregular fluctuation in the annual yield of the fishery is partly accounted for by the natural waxing and waning in numerical strength of the fishable stock. This, in its turn, is a sequel to the unequal production of young from year to year. Reliable evidence, direct or indirect, as to the brood production of to-day is therefore a portent for good or ill in the fishery of to-morrow. Hence, the announcement that there is indication of a positive correlation between brood production and the January temperatures of the sea, in the vicinity of the Varne lightship, is one of much interest and promise.

Inequality of brood production, however, does not entirely account for good and bad fishing yield. Whether the fishable stock be rich or poor, the best possible catches will only be made when fishing is conducted at the right time in the right place. It is important to know that the yield is best at the time of full moon, and that the most favourable conditions for a productive season is when the October full moon occurs during the second week. The conditions of wind blowing over the fishing grounds must also be taken into account, for it is held that herrings tend to swim into the wind; and it is easy to understand that persistent winds from an unusual quarter may cause the shoals to move away from places which they normally visit and where fishermen expect to find them.

It is not only in connexion with the great East Anglian exploitation of shoals making their way to the spawning grounds that scientific investigation is proving its worth. We know that, in the intervening months between annual spawning migrations, the shoals are ranging the sea in

search of food. Information as to the places in which such shoals are likely or unlikely to be found is thus of real value to fishermen wishing to intercept them. Work in this direction was described in the third and fourth papers of the Norwich symposium. Ingenious instruments and methods have been used in a comprehensive and continuous survey of the floating animal and plant plankton of the North Sea with relation to the movements of herring. Positive correlations between the number of herring caught and their food *Calanus*, and negative correlations with phytoplankton, have already been demonstrated. The practical outcome of this is that fishermen can be assured of a greater return for a season's labour if they will regularly use a plankton indicator in deciding where to set their nets. It has also been shown that the phytoplankton at times forms dense patches which interfere with the movements and shoaling of herring, with serious consequences to the dependent fisheries. The study of the origin, disposition and fate of these patches, therefore, is in itself of major interest to the industry. We must also know whether the observed tendency for the autumn herring shoals of both 1933 and 1934 to mass against the edge of a diatom patch is a regular phenomenon.

A word or two must suffice to deal with a line of investigation about which the symposium was silent. Nothing was said regarding the urgent necessity of a greatly improved market for herrings, to prevent the complete collapse of the British industry. For of what use to the fishermen is scientific aid in his fishing if he cannot sell the catches he is already making without such aid?

E. FORD.

Erosion Surfaces

SINCE Ramsay recognised in 1878 that the even skyline of South Wales represented a plain of marine denudation, uplifted and dissected, upland surfaces of low relief have been recognised in all parts of the world, and their probable relation to the great unconformities of the stratified rock succession has been discussed. Some, following W. M. Davis, have preferred to regard them as sub-aerial peneplains rather than marine features, but few certain criteria exist for distinguishing sub-aerial from submarine surfaces, after uplift and dissection, and each case must be judged on its merits. Recent years have witnessed a concentration of interest upon such features, commonly known as 'platforms'. In America, the work of the late Joseph Barrell, and of D. W. Johnson, has emphasised the importance of this line of study. A committee of the International Geographical Congress, on which Prof. A. G. Ogilvie is the British representative, is at present seeking to organise the work of mapping erosion surfaces in Europe, using an agreed, though tentative, scheme of symbols. Interest has also been fostered by the publication of Prof. Baulig's recent monograph[1] in which high-level platforms are discussed in the context of the daring theory of major eustatic changes of sea-level.

With the field thus fertilised, Sections C (Geology) and E (Geography) devoted a session to a joint symposium and discussion on "Denudation Chronology" at the Norwich meeting of the British Association on September 9. The regions discussed included south-east England, Devon and Somerset, South Wales, southern Ireland, the East Midlands, Yorkshire and the Channel Islands. Any attempt fully to correlate work from so wide an area would be premature, but a most welcome concurrence of opinion was manifest both as to the methods of research and the general results obtained. The histories of denudation in the several areas proved indeed so generally comparable as to point a most hopeful future for such investigation and to foreshadow theoretical results of high importance.

An initial problem to be solved in most areas is the differentiation of older surfaces—stripped planes of unconformity, from those formed during the middle and later portions of Tertiary time. There is a general tendency among the students of the older rocks tacitly to underestimate the erosional work of Tertiary time, and to regard the dominant hill-top surfaces of relict Palæozoic uplands as the basal planes of Triassic, Jurassic or Cretaceous rocks, which, buried far beneath the adjoining plains, rise to join the hill-top surface of the 'Massifs', thus signifying a former wide extension of the sediments above them. So cavalier a dismissal of some sixty million years of geological work is theoretically unacceptable, and as a hypothesis it fails to fit the facts. Wherever they are examined in Britain, the 'fossil peneplains' of pre-Permian to pre-Cretaceous date are relatively steeply inclined away from the Palæozoic uplands. Even if their slope flattened as traced away from the heavily loaded areas of the plains, they must nevertheless have passed far above the

existing hill-top surfaces, having, in general, been destroyed in cycles of erosion which ran their course before the current cycle or its immediate predecessor. Recent American work points to a similar conclusion. The Schooley peneplain which bevels many of the summits of the Northern Appalachians was formerly regarded as a landward continuation of the surface below the coastal plain sediments (the fall zone peneplain). D. W. Johnson gives good reasons for supposing that it is a much later feature[2], probably not younger than Early Tertiary.

These considerations enforce the necessity of beginning work on any general scheme of denudation chronology in south-east England, where surfaces can be dated by reference to known Tertiary deposits. There are two major surfaces in this region: (*a*) the folded sub-Eocene surface, which emerges from beneath its sedimentary cover on the lower slopes of the chalk round the margins of the London and Hampshire Basins, and (*b*) the mid-Tertiary (probably late Miocene) surface which forms the general hill-top plane of the south-east, bevelling the escarpments. Most of the true clay-with-flints rests on this latter surface, which was locally warped down before uplift to admit a Pliocene sea over parts of the area. It is hence difficult in places to distinguish between the late Miocene sub-aerial peneplain and the sub-Pliocene marine surface, largely stripped of its thin veneer of sand and shingle. Later, less extensive, surfaces of Pliocene and Pleistocene date—in reality old valley floors—can be traced throughout the region, and the record is supplemented and confirmed by the testimony of cyclic river-profiles, which reveal former sea-levels, closely comparable with those deduced by J. Hanson-Lowe in the Channel Islands. It cannot be too strongly emphasised that the whole south-eastern region (excluding the margins of the unstable North Sea depression) has evolved under the influence of uniform changes of base-level, during its later history. The last traceable act of warping was that which slightly deformed the late Miocene peneplain

The two major surfaces noted above represent periods of erosion so protracted that corresponding features should certainly be distinguishable in the uplands of the north and west. In south-west England a convenient upper datum in time is provided by the Pliocene marine notch and associated coastal ledge at about 400 ft. O.D. This is unwarped, but the Early Tertiary (pre-Oligocene) surface is evidently largely warped or faulted, as witnesses its depression to low levels along a zone running from Bideford Bay via Petrockstow and the Moretonhamstead syncline to the Bovey Tracey basin. Nevertheless, it may conceivably be represented by the sloping hill-top surface of parts of Exmoor and the Brendon Hills (1,100–1,400 ft.). At lower elevations, there is a 900–1,000 ft. platform and a well-marked very uniform surface which dominates central Devon, ranging in height from 600 ft. to 800 ft. One of these surfaces, probably the latter, is to be identified with the Miocene peneplain of the south-east.

Comparable features have been investigated by A. A. Miller in South Wales and South Ireland. In both regions he finds a sloping surface extending from low levels near the coast to an upper limit at 800-900 ft. This might be interpreted as the product of an advancing or a retreating sea, or even as a sub-aerial feature. It should be added that Prof. Trueman and Miss Goscar find some evidence in South Wales that the general profile is 'stepped' or composite in places, revealing separate platform levels, at 200 ft., 400 ft. and 600 ft , and Miller's work on the river-profiles and the wind-gaps lends some support to such an idea.

In northern England, Prof. H. H. Swinnerton has recognised a high-level surface in south Derbyshire, possibly the sub-Cretaceous plane, but more probably, in the light afforded by the other regions, an early Tertiary feature. Lower platforms representing stages in the excavation of the Trent valley fall into a series generally comparable with those of the Thames valley. Of particular interest has been the discovery by Dr. H. C. Versey, following J. W. Stather and others, of probable early Tertiary deposits on the higher parts of the Yorkshire wolds. These rest on a surface which appears to be traceable in the North York Moors and also, though less certainly, in the Pennine region.

In conclusion, it may be remarked that the study of erosion surfaces is far from being of purely academic interest. From the geological point of view, such surfaces afford a record complementary to that of deposition, but there is a geography as well as a geology of surfaces. Recognition and delimitation of landscape facets is an essential part of geographical analysis, if only because of their influence on soil character and land-utilisation. It is clearly a matter of first importance whether a surface retains relics of an Eocene, Cretaceous or other covering, recently removed, or is mantled by a strongly leached regolith exposed to the atmosphere since Middle or Early Tertiary times. Many agricultural contrasts in Britain can be explained on these lines, and whether in conducting soil-surveys or planning the improvement of agricultural land, such facts should receive full attention. S. W. WOOLDRIDGE.

[1] Institute of British Geographers. Publication No. 3 (1935), "The Changing Sea Level".
[2] D. W. Johnson, "Stream Sculpture on the Atlantic Slope". New York, 1931.

The Interaction of Gases with Solids

THE last important discussion on adsorption phenomena in Great Britain took place in January 1932 at Oxford, under the auspices of the Faraday Society. At that meeting, the topic which evoked most controversy was that of the activated adsorption of hydrogen on metals and on metallic oxides, that is, on solids particularly active as hydrogenating catalysts. While a great deal of work has been done in the intervening four years, it cannot be said that the matter is at all thoroughly elucidated. Meanwhile, however, several new independent lines of attack have been brought to bear on the varied phenomena encountered in the interaction of gases with solids, which may ultimately lead to more precise views on the question of activated adsorption. On November 21, therefore, Prof. E. K. Rideal opened a discussion at the Chemical Society in order to direct attention to recent work and to focus opinion on a subject still in a state of flux.

Many of our modern ideas on the mechanism of heterogeneous catalysis are based on the pioneering work of Langmuir on the interaction of gases with hot filaments. That the subject is far from exhausted is amply demonstrated by the recent work of Roberts[1] with tungsten. The basis of these experiments is the development of two separate physical methods of studying adsorption. The first arises from the fact that the accommodation coefficient of a neon atom on a tungsten surface is particularly sensitive to the presence of adsorbed films. For example, the accommodation coefficient on a bare surface at 273° K. is 0·08. When the tungsten is covered with a layer of oxygen atoms, the value rises to 0·25. The second method consists in actually measuring the heat of adsorption of gases on a clean tungsten filament by determining the rise in temperature (only 0·01°) which occurs when gas is adsorbed.

One of the most surprising results of the application of these methods is that hydrogen is practically instantaneously adsorbed when it encounters a tungsten surface even at so low a temperature as 83° K. If very small amounts of hydrogen are admitted, the gas is completely adsorbed, the heat of adsorption being about 40 kgm. cal. After sufficient hydrogen has been admitted to cover the tungsten surface, that is, one hydrogen atom to one tungsten atom, there is no further adsorption, and therefore no heating of the filament. That the hydrogen is chemisorbed is proved by the high heat of adsorption and by the fact that the film of hydrogen can only be removed (probably as atoms) by heating the filament to 700° K. The chemisorption of hydrogen on tungsten therefore proceeds with a very small energy of activation. This is in marked contrast to the considerable energy of activation observed for metallic powders, such as tungsten, nickel and copper. To prevent sintering, these absorbents cannot be outgassed at high temperatures. Hence it may well be that the surface is not free from gas, and that therefore the phenomenon usually observed is really the interaction of hydrogen with a gas-covered metallic surface. It is a matter for further experiment to decide whether this non-activated type of chemisorption on clean surfaces will be observed with metals other than tungsten.

Similar phenomena occur with oxygen and tungsten: the oxygen is immediately adsorbed. From the heat evolved and the energy of dissociation of molecular oxygen, it may be shown that the energy of desorption of an oxygen atom is about 130 kgm. cal., which is in good agreement with Langmuir's value of 160 kgm. cal. derived from the effect of oxygen on the thermionic emission of tungsten. Oxygen atoms go on in pairs, one oxygen atom to one tungsten atom. As this bombardment goes on, a time will come, if the oxygen atoms are immobile, when only single isolated atoms of tungsten are left. It is evident that an oxygen molecule cannot be dissociated on colliding with these isolated atoms. Instead, it is adsorbed as a molecule with a smaller heat of adsorption. Thus at high enough oxygen pressures, the ordinary film of atomic oxygen, necessarily containing gaps, has on top a relatively dilute film of molecules covering about 8 per cent of the surface.

Having obtained conclusive evidence of the nature of adsorbed atomic films, the next question which arises is the rate of migration on the surface of the solid and the rate of penetration into the body of the metal. One ingenious way of following surface migration has been developed by R. C. L. Bosworth[2]. By means of a positive ion gun, a beam of sodium ions is projected on to a negatively charged tungsten strip. The strip is then heated electrically, the sodium atoms migrating. The progress of migration is followed by allowing a spot of light to fall on the sodium-covered tungsten surface, the resultant photo-electric emission at various positions along the strip serving as an indicator of the surface concentration of the sodium atoms. In this way, the rate of migration may be

determined as a function of the temperature and of the surface concentration.

The diffusion of gases through solids is controlled partly by the interaction of the gas with the surface and partly by processes occurring in the body of the solid, both of these in general being specific, for example, H_2—Pd, O_2—Ag, N_2—W. An exception to the rule is the diffusion of hydrogen, helium, neon, argon, nitrogen and oxygen through silica glass[3]. There is no doubt in the case of the inert gases that the forces which the atoms encounter in their passage through silica are purely of the van der Waals' type. In fact, it may be shown by calculation that the energy of activation for the passage of an inert gas atom through a square of similar atoms can attain values commonly associated with chemical reactions, such as 30 kgm. cal. Migration appears to take place through the solid lattice, for the rate is independent of the firing and other treatment of the silica. With oxygen and nitrogen, on the other hand, the rate is very sensitive to surface imperfections, firing and the like, which would point to the diffusion occurring along slip-planes and cracks in the glass.

Much has been written about the usefulness of deuterium as a tool for investigating the mechanism of chemical reactions. Taken along with the ortho-para conversion, the behaviour of deuterium yields important evidence about catalytic hydrogenation and dehydrogenation reactions. For example, if ammonia and ortho deuterium are allowed into contact with an iron catalyst, A. Farkas has found that the rate of conversion of the ortho deuterium is inhibited by the ammonia, and simultaneously there is a slow exchange reaction resulting in the production of deuterammonia. This shows at once that ammonia partially covers the iron surface, that deuterium is dissociated on the portions not covered with the ammonia, and that the rate of exchange is slower than the dissociation of deuterium molecules, the latter reaction therefore not being the rate-determining step.

These few examples suffice to demonstrate that the field of inquiry is an extending one, and that well-defined progress is being made in drawing a more precise picture of the interaction of gases with solids.

H. W. MELVILLE.

[1] *Proc Roy Soc*, A, 152, 445; 1935
[2] *Proc. Roy. Soc*, A, 150, 58; 1935
[3] R M Barrer, *J. Chem. Soc.*, 378, 1934

Obituary

Mr. F. Escombe

EVERY student and teacher of botany must be familiar with the classic work of Brown and Escombe on the germination of refrigerated seeds; the relative roles of endosperm and embryo in germinating barley; on the static diffusion of gases and liquids in relation to photosynthesis and translocation in plants; the influence of varying amounts of atmospheric carbon dioxide on photosynthesis and plant growth; the interchange of energy between the leaf and its surroundings; the determination of carbon dioxide in the air absorbed by plants, based on the rate of its absorption by a free surface of a solution of caustic alkali; and they will learn with regret of the sudden death of the surviving author of these important researches on October 12. Brown, who was a much older man, died in 1925. Fergusson Escombe, who was only sixty-three years of age, had given up his active career at a comparatively early age owing to ill-health and other circumstances, and thus, though his work will always hold a high place in botanical research, he himself had almost been forgotten, save by a few.

Born in Hampshire in 1872, Escombe went to a preparatory school at Bournemouth and thence to Haileybury for two years. He matriculated in 1892, and later obtained the degree of B.Sc., with honours in botany, at the University of London, from King's College, London. There he won the Carter Gold Medal and Prize for botany. He studied also at Downton Agricultural College, at Neuenheim College, Heidelberg, and at the Kaiser Wilhelm University at Strassburg. Whilst at the latter, he worked on the chemistry of the cell membranes of lichens and fungi, and published a paper on it in 1896, "Beitrag zur Chemie der Membranen der Flechten und Pilze" (*Hopp.-Seyl. Z. Phys. Chem.*, 22, 288–306; 1896–97), a preliminary investigation to determine the existence of chitin and cellulose in these groups. This showed his early leaning towards biochemistry.

Shortly afterwards, Escombe went to work with Brown at the Jodrell Laboratory, Kew, on the researches which were published jointly in the Royal Society *Proceedings* and *Philosophical Transactions*, 1897–1905, and which gained for Escombe an established place in botanical science. There is no necessity to summarise these researches—indeed it would be quite impossible except at great length—since they have passed into botanical history and are described in every botanical textbook. They marked, however, a great advance in the state of knowledge then of the essentials of the physiological processes of germination and nutrition. Being reduced to mathematical precision, the results were enunciated so that in some cases they could be stated in formulæ. Special methods and apparatus had to be devised to carry out such delicate experiments, and novel

methods of study adopted to demonstrate the physical laws that controlled plant activity.

Following these fine contributions to biochemical and biophysical science, both Brown and Escombe took up appointments in the Scientific Research Laboratory of Messrs. Guinness and Co. at Dublin, Brown as director and Escombe as vegetable physiologist. The work on improving the malting qualities of barley was published (unsigned) in the Laboratory *Transactions*. Escombe worked there from July 1901 for three years. Readers of NATURE will remember the excellent reviews by Escombe on German biochemical works by Emmerling, Schulz, Czapek and Wieler about this time (1902–6). He wrote for *Science Progress*, 1897–98, two papers on germination generalised from the Royal Society researches.

Escombe then held the post of lecturer in botany and head of the Botanical Department at the South-Eastern Agricultural College, Wye, following Mr. (now Sir) Albert Howard, and at the same time gave County Council lectures in Kent and Surrey. He was at Wye from July 1905 until July 1907. This ended his active career at the age of thirty-five. He returned to Kew to do some physiological work at the Jodrell Laboratory in March and April 1910. After that, save for work during the Great War at the Admiralty (1917–22), he retired, from ill-health and other circumstances, to his native county, Hampshire (where also lived his great friend, Dr. D. H. Scott), living with his family, and latterly, since 1929, in rooms at East Meon, where he made his home until his death.

There Escombe took an active part in the life of the village, and his chief hobbies were reading and walking, and exploring the flora and fauna of the district. He studied the two Arums, and carried out an exhaustive series of researches on their life-history and ecology, later studying that difficult group of trees, the elms. In both cases he wrote valuable notes upon the species, which, with excellent material, he sent to Kew. He also there wrote a treatise on "Buds in Winter". All these should be published posthumously, since they are characterised by the same masterly grasp of details, and the clear and well-conceived enunciation of principles, or of classification, with brilliant and sound analogy, which marked the Royal Society papers published in conjunction with Brown.

Fergusson Escombe was a very reserved man, and of a refined nature. Properly understood, he was a charming companion. He had a most gentle nature, and a great love of animals and for children and old people. His scientific work was characterised by thoroughness and avoidance of hurry, and his experiments were conducted with carefulness and exactitude. It seems a tragedy that a man gifted by Nature with exceptional scientific ability, enlarged by special training, and with so sound a knowledge of biochemistry and physiology, should have had to disappear, through ill-health, from the arena of science at so early an age. Ill-health caused his career to be prematurely shortened, and heart failure has now snatched him from the world, his relations and friends all too soon. A. R. H.

Senator Paolo Orsi

WE regret to record the death of Senator Paolo Orsi, the distinguished Italian archæologist, which took place at Rovereto on November 8 at the age of seventy-six years.

Paolo Orsi was born in 1859 at Rovereto, which was then Austrian territory, but on completing his studies he settled in Italy. In 1888 he became an inspector of the Museum of Syracuse, and soon afterwards was appointed its director. He applied himself to the exploration of the antiquities of the island of Sicily, and by his discoveries revealed the sequence of Siculan culture from early chalcolithic times down to the period of Greek colonisation, a sequence in which he showed that four separate types of civilisation were to be distinguished. His excavations, more particularly in the neolithic villages of Stentinello, the burial grounds of Megara near Syracuse, and at Gela, made his museum one of the richest, and in some respects of the first importance, for the study of certain aspects and periods of Mediterranean archæology.

In 1907, Orsi was appointed *superintendente* of Calabria and Basilicata. Here he continued his investigations and discovered the pre-Hellenic sites of Torre Galli, near Monteleone, and of Canale, near Locri, both of crucial importance for the study of the prehistory of the Calabrian peninsula. He undertook a number of excavations under the auspices and mainly at the expense of the Societa Magna Græcia, of which he was president at the time of his death. Among his discoveries was that of an Ionic temple at Locri, the only known example in Magna Græcia. The material from these excavations will be exhibited in a museum now in course of construction at Reggio-Calabria. He was also an authority on Byzantine antiquities, which he had studied in both Sicily and Calabria.

At the close of the Great War, Orsi took up his residence in retirement at Rovereto. He was a member of the Accademia dei Lincei, and was made a Senator in 1924. He was an honorary member of the Society for the Promotion of Hellenic Studies and an honorary fellow of the Royal Anthropological Institute.

WE regret to announce the following deaths:

Prof. James H. Breasted, professor of Egyptology and oriental history in the University of Chicago from 1905 until 1933, and director of the Oriental Institute, Chicago, on December 2, aged seventy years.

Prof. J. D. Cormack, C.M.G., C.B.E., regius professor of civil and mechanical engineering in the University of Glasgow, on November 30, aged sixty-five years.

Prof. David C. Gillespie, professor of mathematics in Cornell University, for several years editor of the *American Mathematical Monthly*, on October 13, aged fifty-seven years.

Prof. J. E. A. Steggall, emeritus professor of mathematics at University College, Dundee, in the University of St. Andrews, on November 26, aged eighty years.

News and Views

The Royal Society: Officers and Council

THE anniversary meeting of the Royal Society was held on Saturday, November 30, being St. Andrew's day, and the following officers and members of council were elected: *President:* Sir William Henry Bragg; *Treasurer:* Sir Henry George Lyons; *Secretaries:* Sir Frank Edward Smith, Prof. Archibald Vivian Hill; *Foreign Secretary:* Prof. Albert Charles Seward; *Other Members of the Council:* Prof. Edgar Douglas Adrian, Mr. David Leonard Chapman, Prof. Arthur William Conway, Dr. William Henry Eccles, Prof. Arthur Stewart Eve, Prof. Louis Napoleon George Filon, Dr. James Gray, Sir Alfred Daniel Hall, Dr. Stanley Wells Kemp, Sir Patrick Playfair Laidlaw, Sir Gerald Ponsonby Lenox-Conyngham, Dr. Gilbert Thomas Morgan, Prof. Robert Robison, Dr. Bernard Smith, Prof. Walter Stiles, Mr. Wilfred Trotter. An unusually large number of fellows took part in this election on account of a notification that it was to be contested. Several months ago, a group of about ninety fellows of the Society signed a memorial advocating certain changes in the methods of nominating and electing the officers and members of council and in their periods of service. Following up their suggestions, the memorialists substituted other names for those of fellows nominated officially as president, treasurer, two secretaries, and foreign secretary, and of four members of council. Fellows were not asked to support the individual claims of those included in the unofficial list, but to record their votes for them as an expression of no confidence in the existing methods of selecting officers and council. The result of the ballot was nearly ten to one in favour of the Council's list printed above, the number of votes for each officer and member of council in this list being about 190 and that of fellows in the unofficial list being about 20. In the absence of a postal vote, it may therefore be assumed that the general body of fellows of the Society are satisfied with the existing rules and with the statement issued by the Council after full discussion of the changes suggested by the memorialists.

Industry and Technical Education

THE Right Hon. Oliver Stanley, president of the Board of Education, distributed prizes and certificates at the Northampton Polytechnic, Clerkenwell, on November 28. During the course of his address, Mr. Stanley referred to the changes which have been accelerated by the War and which have resulted in the loss of the advantage as an industrial nation which we acquired a century earlier. Yet with all these difficulties in the way of production, we have got to compete if we are to live; and we are being driven more and more to rely on superior skill, superior technique, superior training and superior workmanship, to take the place of those more fortuitous advantages which used to give us our superiority before the War. We can only regain the prosperity of our own traditional industries if we adopt new and up-to-date methods. We are forced to keep ahead of new and severe competition in the new industries, and it is natural that we should turn to institutions like the polytechnics to ask how they can help and are helping both with the old and with the new. Speaking of the type of training for which polytechnics are responsible, Mr. Stanley said that in talking with leaders of industry about technical education he has found everywhere the feeling that colleges should keep in closer touch with actual experience in the workshop. From this point of view he commended the 'sandwich' course of training in engineering, and expressed his regret on learning from the Principal's report that, owing to changes contemplated in the University of London regulations for degrees in engineering, difficulties have arisen with regard to the organisation of such a course in the future.

The Engineer and the Community

IN an address to the Birmingham and District Association of the Institution of Civil Engineers on October 31, Mr. C. H. Bailey made an eloquent plea for wider vision and much closer concern on the part of the engineer with the consequences of his work. We live to-day in an engineer's world, he said, yet an attempt to give a continuous direction to the efforts of the engineer is needed, and in the past, engineers have too lightly assumed that all their achievements result in benefits to their fellow men. Machines are neither wholly good nor wholly bad. They are bad in so far as they hinder men and women from developing creative skill of hand and eye; the mere use of better and more abundant goods can never compensate for the loss of constructive opportunities or powers. It is certain, however, that such production must go on, and that the engineer must continue to strive for more and more efficient machines while mankind learns to adapt itself to the new conditions. While, however, the engineer has transformed our powers of production and means of communication, we are still attempting to force these inventions into an economic, financial and political system which they do not fit. On the other hand, these same developments in production and communications have brought men closer together and made them more dependent on one another. At the same time, the engineer has given the world a greater chance of real freedom than ever before, if we learn to use our new resources and try to modify the new conditions, seeking to create new beauty where we have destroyed. While the engineer should beware of extravagant claims to a larger share in the control of the community, he should endeavour to participate more effectively in the planning required under the new conditions, and to devise some form of co-operation which would make available the benefits latent in his achievements.

Science and the Architect

DR. R. E. STRADLING, director of Building Research under the Department of Scientific and Industrial Research, opened a materials gallery at the Liverpool School of Architecture in the Leverhulme Building of the University of Liverpool on November 29. In his address on the "Architect and Building Materials", Dr. Stradling said that the architect is required to create some form of protection, usually from the weather, which shall meet some intimate practical requirement of human existence, and in a progressive society meet it in such a way that beauty is added to everyday life. It seems almost self-evident that the knowledge of materials must be an ever-present mental background upon which the architect's mind must instinctively call if his artistic ability is to have reasonable scope. He must be equipped to meet his modern conditions, and there is an absence of adequate training on this side. In traditional English house design one usually finds a pitched roof with appreciable eaves, reasonable sills at the top and bottom of windows and doors, the walls constructed of brick or stone, or may be rough cast. No matter whether this type of design is artistically good or bad, such construction is usually thoroughly weatherproof if reasonably carried out in traditional materials. A typically modernist design consists of a box-like structure with flat roof, no weather projection over parapets, windows or doors; walls rendered in smooth Portland cement rendering. From inquiries received at the Building Research Station, it seems such structures are often anything but weather-proof. Before discarding old forms, it is essential to make sure that the new ones meet the essential protection requirements for which the building industry really stands. The real architect-artist is urgently required with all the pioneering fire of which man is capable, but he must be properly trained to meet modern conditions. This can only be done by very much more intensive science work than is usual at present, for he must have a very real knowledge of the media in which he is to design.

Minoan Survivals in Later Crete

SOME remarkable vistas in the history of European civilisation are opened up in the report by Sir Arthur Evans of the discovery in October last of a temple of early Greek age in the island of Crete. The temple, which has been excavated by Dr. Marinatos, Ephor of Antiquities, is situated in the eastern part of the island on the hill site of the ancient town of Dreros, overlooking the lagoon of Spinalunga. It dates from the early part of the eighth century B.C., and is, therefore, the earliest known temple of the Greek age in the island. It differs, however, in proportions and character from other early Greek temples, and Sir Arthur in his communication in *The Times* of November 20 fully concurs in the view of Dr. Marinatos that it presents close affinities with pre-existing Minoan cults, such as might be preserved in an ancient Cretan tradition. He recalls that it was in this part of the island that the ancient Eteo-Cretan language survived down to historic times. Among the more noteworthy objects of the shrine, which was found in the characteristic Minoan position on the back-wall of the cella, are the cist-like altar filled with earth and quantities of goats' horns, reminding Dr. Marinatos of the altar erected by Theseus in honour of Ariadne, his Cretan consort, and bronze figures made of hammered plates, which had been fitted on to a wooden core, the first known examples of a technique to which reference is frequently made by Greek writers. Of these figures two, one male and one female, are evidence of the persistence of the 'mother and son' cult, which provides Sir Arthur with a link in a chain of evidence by which he traces the fundamental religious belief of the eastern Mediterranean from Knossos to Bethlehem.

Explorations in New Guinea

ADDITIONAL interest was attached by recent controversy to the account of his explorations in New Guinea which Mr. Michael Leahy gave to the Royal Geographical Society on November 21. It will be remembered that it has been suggested that Mr. J. G. Hides, who recently brought back some remarkable data relating to the unknown peoples he had encountered in the interior, had been in touch with some of the peoples of the Mount Hagen area discovered by Mr. Leahy, of whom an account has already reached England through Mr. E. W. P. Chinnery, the Government anthropologist of Papua. (See NATURE, September 1, p. 328, August 17, 1935, p. 251 and August 24, p. 290.) The culture of the Mount Hagen people as described by Mr. Leahy does indeed present certain features of similarity, such as the interest the people display in their gardens, which justify the comparison. Mr. Leahy's cinematograph film, especially in the war scenes—he was fortunate enough to obtain a record of an inter-tribal war in actual progress—gave a detailed picture of a remarkable, and in its environment unusual, culture. Especially interesting to archæologists was his report of the custom of cutting off a finger-joint at the death of a relative. This custom of finger mutilation is widespread among the more primitive peoples, and, as is well known, evidence of it is to be seen in the imprints of hands found among the prehistoric cave and rock paintings. The Mount Hagen peoples also practice preserving the skulls and some of the bones of their deceased relatives, which are placed in shrines along the road-side. It is to be noted that they are not cannibals, and expressed horror at the suggestion, although the practice exists among tribes nearer the coast. As a whole, Mr. Leahy's report has provided much interesting material for comparative study.

Stone Age Culture in Colorado, U.S.A.

DR. FRANK H. H. ROBERTS, JR., of the Bureau of American Ethnology, has resumed his investigation of the Lindenmeier site in Northern Colorado, U.S.A. (see NATURE of October 5, p. 535), and for some weeks has been engaged in driving trenches in various directions near the habitation and factory site of Folsom man which he discovered in 1934. No less

than seven hundred implements belonging to this early phase of the American stone age, it is stated in a communication issued by Science Service of Washington, D.C., have been discovered, among them being a number of new types. The variety in type of the implements continues to be a marked feature of the site. A find of considerable importance is recorded, which corroborates conclusively previous evidence for the contemporaneous existence in this region of man and an extinct fauna. This is the discovery of the vertebra of a bison, in which is still embedded the stone point of the lance or dart with which it had been struck by the primitive hunter. The vertebra belongs to the extinct form of bison already found here and elsewhere in association with the artefacts of Folsom man. It has already been pointed out (see NATURE, *loc. cit.*) that the Lindenmeier site gives *in situ*, for the first time, a view of the Folsom implement as forming part of a cultural complex, and thus justifies the use of the term 'Folsom culture'. To this complex must now be added an art form, the first known in this early phase of culture, which appears on a flat bone disc showing decorative marks around the edge. No information is as yet available on the further investigation of the stratigraphy of the site and its relation to adjacent gravels, from which it is hoped to attempt a dating of this centre of the Folsom culture.

A Thames Barrage

WITH the arrestive title of "Dam the Thames", a brochure has been issued by the Thames Barrage Association advocating the scheme put forward a short time back in a paper read before the London Society by Mr. J. H. O. Bunge, who is honorary secretary of the Association since formed to promote the impounding of a large section of the Thames estuary. The original proposal is modified in respect of the position of the proposed barrage, which it is now suggested should be located at Woolwich. The cost of the scheme is estimated at about 4½ millions sterling, but, as has been abundantly demonstrated in other projects of corresponding magnitude, this figure must be received with a certain amount of reserve. According to the pamphlet, the resultant savings, enumerated under eighteen categories, would aggregate about £611,000 per annum, representing a capitalised value of 20 millions sterling. Some of the items of this calculation seem to be based on data of a rather uncertain character, so that here, too, the estimate must be considered more or less speculative. An official, public inquiry into the merits of the scheme is urged on the grounds that the scheme, if carried out, would be of great advantage to navigation in maintaining a permanent water level in the river and so enabling craft to move freely, and independently of tidal restrictions, in and out of the docks, and to and from the riverside wharves above Woolwich; in excluding sewage effluent at present brought up-river by tidal flow from the outfalls at Crossness and Barking; and in avoiding the risk of flooding at times of abnormally high tides. Various other benefits are categorically enumerated.

ALTHOUGH an inquiry, which would involve some time and expense, might resolve some of the problems connected with the formulation of the barrage scheme, it must be borne in mind that an enterprise of this magnitude cannot be embarked upon without a considerable degree of risk to important interests, however propitious the general circumstances may appear to be. It will be recalled that a cognate scheme, the Severn Barrage, was definitely promoted by the Government and became the subject of a prolonged and searching inquiry by experts; but the findings of the committee, although favourable, have not, so far, resulted in the materialisation of the project, which, in the language of the Ministry of Transport, was to bring "within the reach of all classes of the community the blessings of light, purity and power". It is also to be noted that the Port of London Authority has had the present proposals before it, and has not accorded them its support. The reasons have not been stated, but it is clear that they were such as to carry preponderant weight with those most intimately concerned with the great shipping and commercial interests of the port. This does not, in itself, suffice to condemn the project; but it rather discounts the florid assertions of the promoters, and justifies an attitude of caution and reserve.

Ice Accretion on Aircraft

LECTURING before the Royal Aeronautical Society on November 4, Mr. Lockspeiser, of the Royal Aircraft Establishment, Farnborough, described experiments upon this subject which have led to the recommendation of a certain method of combating this. It consists of forcing ethylene-glycol through a porous leather strip which can be attached to, or form part of, those surfaces upon which ice appears to form. This presents the greatest danger when on the leading edges of the various lifting surfaces and the airscrew. In such cases it not only adds to the weight to be carried but it also reduces the efficiency by changing the shape, and in the case of the propeller it causes out of balance forces that necessitate slowing it down with still further loss. The action of the ethylene-glycol is to prevent the ice from adhering to the surface. Mr. Lockspeiser referred to thermal methods for prevention of ice formation, and mechanical methods for dislodging it, but said that neither of these has the simplicity and the general application to all cases of the evaporation method. Thermal methods, using the engine heat to warm the wing surfaces, may become more attractive upon larger thick-winged monoplanes, where the 'plumbing' difficulties would be less. Mechanical methods of dislodging the ice from the planes have been used for some time in the United States, but are not applicable to the propeller. Experiments are now being made with devices similar to the British ones, using rubber sheathing and oil. The experiments described were undertaken originally for R.A.F. requirements; but the question was considered to be so vital to civil aviation, that the results have been made public and the device is to be marketed by the Dunlop Company.

Forestry Research

THE Forest Products Research Laboratory at Princes Risborough has begun a new issue entitled *Forest Products Research Records*, of which Nos. 1 and 2 have been issued (H.M. Stationery Office, 1935). No. 1 deals with the testing of timbers at the Forest Products Research Laboratory, and describes in clear language the *raison d'être* for the Laboratory and the objects at which it aims. It is pointed out that the object underlying the work of investigating the properties of timbers, the practical application of the results of the tests and their importance to the timber-using professions and industries as well as to timber merchants, are not fully understood. Nor are the facilities offered by the Laboratory for supplying information fully realised. It is the object of the *Records* to supply this want. The first number describes the work of the different sections of the Laboratory under the headings: structure, timber physics, seasoning, timber mechanics, woodworking and preservation, with sections dealing with entomology, mycology, wood chemistry and utilisation.

IN the second number of the *Forest Products Research Records* the subject of "The Strength Tests of Structural Timbers" is discussed. Both Canada and the United States have been engaged upon research work in this direction for a number of years. Until recently the subject has received very little attention in Europe, which accounts perhaps for the fact that handbooks providing tables do not agree among themselves owing to important factors being overlooked by earlier investigators. For example, mention is made of one record which cites Memel redwood as 60 per cent and English oak as 20 per cent stiffer than greenheart, whereas it has now been established that redwood and oak are approximately equal in this property and no more than half as stiff as greenheart. With the object of coming into line with the Canadian and American research work, an extensive programme of tests was commenced some time ago at Princes Risborough. Work was started in testing redwood from the White Sea and from Geflé. The Timber Trade Federation became interested in the work, and with its co-operation the scope was considerably extended. The results of the tests on redwood from those two areas are detailed in the *Record*.

New Box Testing Laboratory

THE Department of Scientific and Industrial Research has set up equipment at the Forest Products Research Laboratory for testing packing-cases, boxes, etc., under stresses similar to those encountered during rail or road transport. The installation is the first of its kind in Great Britain, but several are in use in the United States, where the experience gained has considerably reduced the claims for damages paid by the railways. The plant at Princes Risborough tests both the endurance and strength of the boxes. For the former test, the cases are placed inside a large rotating drum, which revolves twice a minute, wooden baffles on the inner face causing the article to fall in different positions in turn. A moderately well-made container was found to collapse after about thirty falls, whereas one of really good design could withstand 150 or more falls. A 'dropping machine' tests the resistance to falls on the face, corner or edges at will, while in a further apparatus resistance to crushing can be determined. The efficiency of nailing, different types of fastenings and packings are also being investigated, and on behalf of the Ministry of Agriculture special tests are being made with the view of drawing up a standard specification for fibre-board containers for National Mark eggs. The Box Testing Laboratory will be available to manufacturers and others who wish to study possible improvements in methods of box construction and in the packing of contents to give the greatest protection. The scale of charges, and a statement of the conditions under which tests will be made, can be obtained from the Director, Forest Products Research Laboratory, Princes Risborough, Bucks.

Air-Conditioning in the Tropics

ATMOSPHERIC conditions in the tropics have serious effects, both physical and mental, upon the inhabitants. In an article in the *Electrical Review* of November 8, Prof. C. A. Middleton Smith of the University of Hong-Kong states that it is difficult for those who live in temperate regions to realise the depression produced on human energy by living for months in a climate with a night and day temperature of about 90° F. and a relative humidity of more than 90 per cent. With the help of electrical power and the new methods of producing cold mechanically, it is now possible to manufacture climatic conditions that are almost perfect. By the use of a small electrically driven machine in his private room in the University, Prof. Smith can make the climate in it as pleasant as on a summer day in England. Six hours after the machine has been at work, it has extracted a gallon and a half of water from the air in the room. The effect of the two contrasting atmospheric conditions within and outside the room upon bodily comfort is most marked, and he has found by experience that he can double his lecture hours and yet be less fatigued at the end of the day. He says that no educated person in the tropics who can afford an electrically driven refrigerator would now risk having a 'disease carrying' ice box. He has for the last sixteen years advocated air-conditioning in the tropics. One of the most extensive applications of the system in China to-day is that of the new million pound building of the Hong-Kong and Shanghai Bank. There are six air-conditioning plants for the whole building. Electric motors are used for driving the ammonia compressors. Three pumps are required for the condenser water circulation and there are six inlet fans which drive 229,000 cubic feet of air a minute. The total rating of the electric motors used is 800 horse-power.

Radio Research Laboratories Abroad

THE rapid and widespread growth of radio communication and its associated industries has been one of the most notable events during the past fifteen

years. The inception and development of broadcasting, and later of television, resulting from the earlier introduction of the thermionic valve to industry, have revolutionised the scope of normal commercial telegraphic and telephonic communication. These developments have naturally been accompanied by the establishment of radio frequency research laboratories in all parts of the world, some of these being controlled by government administration, while others are associated with private enterprise. The issue of *La Nature* of September 15 is devoted to an illustrated account of several such radio research laboratories. Much space is devoted to the work of the French institutions, Le Laboratoire National de Radio-Electricité, Le Laboratoire du Comité Consultatif, Les Laboratoires de Recherches du "Matériel Téléphonique", and to the private laboratories engaged on television. In addition, however, the work of the Heinrich Hertz Institute and of M. von Ardenne in Berlin are described briefly; while attention is also devoted to the Philips Laboratories at Eindhoven, the Bell Telephone Laboratories in New York, the Italian Television Laboratory and that of the Baird Television Laboratory, the only English laboratory mentioned. Further articles deal with work in France in connexion with broadcasting, valve manufacture and research on the interference problem. The whole issue presents an interesting summary of the scope and position of research in the institutions enumerated.

Solar Physics Observatory, Cambridge

IN his twenty-third annual report to the Solar Physics Committee the Director of the Solar Physics Observatory, Cambridge, is able to point to a number of interesting results obtained from a particularly active year. To begin with, the 3-ft. Common mirror has been refigured by Dr. Burch, who has developed a special new method of testing paraboloids in this connexion. The performance of the mirror is greatly improved, and it is hoped to improve the 10-in. secondary mirror used with this large mirror and so obtain really good definition with the 3-ft. telescope. The year's work on stellar spectroscopy has been notable on account of special observations made during the eclipse of ζ Aurigæ and for the work on Nova Herculis. A very special effort was made, and altogether 284 spectra were secured on 137 nights between December 13, 1934, and July 31, 1935. This is a very fine performance for the climate of Great Britain, and was only made possible by enthusiastic team work by the staff and research workers at the Observatory. An item of interest is the attempt made by Drs. Redman and Bullard to determine the diameter of Antares by observing the brightness during an occultation by the moon. Unfortunately, the apparatus broke down at a critical point in the observation, but there appears to be nothing unworkable in the method, which is of extreme interest, and it is to be hoped that the experiment will be repeated at the next favourable occultation. The solar work has continued, perhaps the most noteworthy item being the accurate determination of the central intensity of the line at 4227 A. (due to Ca^+) by Dr. Redman, the result being 2 per cent—possibly the lowest central intensity yet accurately measured. The Observatory has arranged to send an expedition to observe the total solar eclipse of June 19, 1936, the site chosen being in the island of Hokkaido. Finally, the work on meteorological physics has been continued, and the work on the Fe^+ laboratory spectrum has been brought to a successful conclusion, 58 new multiple terms and 157 levels having been determined.

Archæology in South-East Essex

LOCAL archæologies and local histories have a useful function which is seldom fulfilled satisfactorily. To write them successfully requires a nice perception of the balance between the foreground of local interest and the background of the general trend of history or cultural development. Of the importance of the detailed record of local finds there can, however, be no two opinions. The studies of East Anglian archæology which we owe to Sir Cyril Fox have demonstrated the almost kaleidoscopic changes in the generalised picture as the records of local finds are brought more and more into focus. An excellent example of a method of treatment of local antiquities, which may be followed to advantage, is afforded by "The Archæology of Rochford Hundred and South-East Essex" by Mr. William Pollitt (Southend-on-Sea Museum, Handbook No. 7, pp. 59 with 22 plates, 6*d.*), in which the author follows up a survey of the archæology of the district from pre-palæolithic down to and including Saxon times with a detailed list of the 'finds' in the area, classified according to period and arranged under parishes, the present location of each specimen being noted where known. The distinction to be drawn between south-east Essex and the central and north-western areas of the county on geographical lines is no less apparent in its archæology. For this reason, if for no other, the general background becomes of no little importance for the appreciation of the significance of the finds. Here, it will be found, fully adequate provision has been made for the needs of those who will use the handbook. A map, or series of maps, showing the localities in which the antiquities were found, would have been a useful addition to the ample and excellent illustrations.

Shipbuilding by Welding

ELECTRIC-ARC welding has now arrived at the stage where it is recognised as an important aid to shipbuilding, and its field is being extended so rapidly that there are few shipbuilders or repairers who do not now avail themselves of its use. With this statement, Messrs. N. M. Hunter, vice-president, and H. W. Townshend, associate member, opened a paper read to the North-East Coast Institution of Engineers and Shipbuilders on November 15. They deal with the subject descriptively, and explain the methods used in the fabrication of various parts of the hull structure. The amount of work now done by welding and the marked advantages gained in some instances testify to its growing importance. Welding the steel decks has, for example, produced

water tightness, greatly to the benefit of the crews, while in trawlers the welding of seams has eliminated the trouble with loose rivets caused by the impact of the heavier portions of the fishing gear. It is inevitable that this method will profoundly modify both the design and the building of ships, as the pre-construction of parts is more suitable to the technique of welding.

Catalogue of Earthquakes, 1925–30

ALL those who have used the late Prof. Turner's catalogue of earthquakes for the years 1918–24 will welcome its continuation for the next six years by Miss E. F. Bellamy "as a contribution to earthquake science and as a personal memorial of respect to Prof. H. H. Turner". The catalogue (British Association, Burlington House, London, W.1. 2*s*.), as before, is compiled from the International Seismological Summary, and gives for each earthquake the time at the origin, the position of the epicentre, the number of stations providing records of the earthquake, the last occasion on which the same focus was in action, and the number of "minor entries" or records that are not sufficient to determine the position of the epicentre. The appendix contains notes on earthquakes with unusually deep foci, etc. The number of new epicentres determined is 1,052, raising the total number of known epicentres to 6,215. A remarkable feature of the catalogue is that, with its thousands of entries, it yet seems unusually free from errors, printer's or otherwise, only one so far having been discovered (Nov. 31 for Nov. 13, p. 12).

Investigation of British and Irish Earthquakes

THE study of British and Irish earthquakes, carried out by Dr. C. Davison between 1889 and 1916, has been resumed by Dr. A. T. Dollar, who appeals for assistance in completing the catalogue of those earthquakes which occurred between January 1, 1916, and the present date, and also in recording future disturbances of the same kind. Personal experiences, or relevant cuttings from accounts in scientific journals and newspapers are sought. To facilitate the reporting and recording of data, a questionnaire and circular letter will be forwarded (together with a stamped, addressed envelope) on request to Dr. A. T. Dollar, Emmanuel College, Cambridge.

An Earthquake Research Commission for India

THE Bihar earthquake of 1934 and the Quetta earthquake of the present year have shown the need for an Earthquake Research Institute in India on the same lines as that which has done such admirable work in Japan. A recent issue of *Culture and Science* (1, 233, 274, 288; 1935) has several paragraphs on the subject. A committee of the Geological Survey, consisting of Dr. A. M. Heron, Mr. W. D. West and Mr. J. B. Auden, has drawn up a list of Indian stations at which it is desirable that seismographs should be erected. The list was communicated to the Council of the National Institute of Sciences, India, and it was agreed that the Institute should urge the Government to instal instruments at the places mentioned. The Council has also appointed a subcommittee—Dr. S. Banerji, Dr. M. N. Saha, Dr. N. R. Sen and Mr. W. D. West (secretary)—to advise the Institute on seismological questions, and it was considered that the subcommittee might afterwards be merged into an Indian National Commission for the study of earthquakes. It is satisfactory to learn from the daily Press that the Government is contemplating the appointment of such a commission.

Centenary of Ampère

ACCORDING to the *Revue Scientifique* of October 26, arrangements are being made at Lyons to hold an exhibition next spring in connexion with the commemoration of the centenary of the death of the eminent French physicist, André Marie Ampère. The exhibition will be arranged to illustrate the many applications of electricity. Ampère was born at Lyons on January 22, 1775, being the son of a merchant of that place who was beheaded during the Terror. He became a professor at the Ecole Polytechnique in 1805, and was elected a member of the Paris Academy of Sciences in 1814. His discovery of the fundamental laws of electro-dynamics was made in 1820. His death took place on June 10, 1836, at Marseilles, where he was buried, but in 1869 his remains were transferred to the cemetery at Montmartre, Paris. A statue of him was erected at Lyons in 1888.

Exhibition of Microscopes

MESSRS. W. WATSON AND SONS, LTD., have arranged an exhibition of microscopes to be held in the Central Hall, Westminster, London, S.W.1, on December 9–14. A large number of representative microscopes will be on view, many with prepared slides already mounted. The object of the exhibition is not only to popularise the microscope, but also to demonstrate its utility in various forms of scientific inquiry, in biology, geology, metallurgy, etc. Some telescopes will also be on view. Messrs. Chance Bros. will exhibit various glass products and Messrs. Kodak will exhibit different types of photomicrographs. The Quekett Club is arranging an exhibition of various slides, including specimens of living pond life. During the exhibition, the following lectures will be delivered: "The Part the Microscope plays in the Scientific Control of the Railway", by T. H. Turner, on December 10; "The Microscopist at the Seaside", by Martin Duncan, on December 11; "The Manufacture of Optical Glass", by H. C. Rands, on December 12. The lectures are at 7 p.m. The exhibition is open to the public free of charge. Catalogues and further information can be obtained from Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

Another Large Sunspot

FOR the third time within a month, a new group of sunspots large enough to be seen with the naked eye has appeared, and is in transit across the sun's disk from November 26 until December 9, the date of central meridian passage being December 2·1.

The area of the present group, which consists of a long stream of spots over 100,000 miles in length with a large component in the middle, increased from about 400 millionths of the sun's hemisphere on November 27 to 1500 millionths on November 29. Since the typical curve of growth of large spots shows the maximum area to be reached between the fifth and tenth days after their initial formation, it is probable that the group may grow still larger before it disappears around the western limb. In any event, a maximum area of 1500 millionths has not been equalled since February 1933, when the last big group of the preceding cycle (ending about 1933·8) was recorded.

Announcements

PROF. F. O. BOWER, emeritus professor of botany in the University of Glasgow, has been elected a corresponding member of the Prussian Academy of Sciences.

PROF. W. H. HOFFMANN, of the Finaly Institute of Havana, has been elected president of the recently founded Cuban Society of Biology.

SOVIET RUSSIA has fifty aeroplanes fitted up as small hospitals, the smallest having room for three patients, a doctor and two assistants. In urgent cases, important operations can be performed during flight.

A CONFERENCE on "Mechanization in Mixed Farming" will be held under the joint auspices of the School of Rural Economy, the Institute for Research in Agricultural Engineering and the Agricultural Economics Research Institute of the University of Oxford at Rhodes House, Oxford, on January 7–10. The opening address will be delivered by Prof. J. A. S. Watson, Sibthorpian professor of rural economy in the University. Further information can be obtained from the Conference Secretary, Institute for Research in Agricultural Engineering, Parks Road, Oxford.

THE seventh Pan-Russian Congress of Balneology will be held at Moscow under the presidency of Prof. Danielevsky on December 25–31, when the following subjects will be discussed: the balneological resources of the Soviet Union and the immediate prospects of their utilisation; mineral waters and the indications for their application; radioactive waters; comparative action of sulphurous and bicarbonate waters; medical climatology and climatotherapy; bath treatment of children's diseases. Further information can be obtained from the organising committee, Boulevard Novinsky 9, Moscow.

AT the Sixth International Congress of Genetics held at Ithaca, New York, 1932, a Permanent International Committee of Congresses of Genetics was elected consisting of representatives of fifteen different countries, and Prof. Otto L. Mohr, professor of medicine in the University of Oslo, was elected chairman. This committee has accepted the invitation of the Academy of Sciences of the U.S.S.R. to hold the Seventh International Congress in Moscow and Leningrad in 1937. The date of the Congress will be decided upon later. It may be mentioned that in 1937 an All-Union Agricultural Exhibition will be held in Moscow, which undoubtedly will prove of great interest to many members of the International Congress on Genetics.

THE issue of "Illustrations of New Conifers" by the late H. Clinton-Baker and A. Bruce Jackson, in one volume at 84*s*. is announced. The book will supplement the "Illustrations of Conifers" issued more than twenty years ago. It will be published by Messrs. Simson and Co., Ltd., 12 and 14 Parliament Square, Hertford, Herts.

WE have received from Messrs. Flatters and Garnett, Ltd., 309 Oxford Road, Manchester, 13, their new Catalogue "S" of stains and reagents for microscopical work, chemicals, and bacteriological culture media. A new item included is their "neutral mountant" for mounting microscopical specimens in the place of the ordinary Canada balsam. This is stated to be quite neutral in reaction and non-crystallisable, and not to affect stains.

WE have received the first number of *Revista de Quimica e Farmacia*, July 1935, published at Rio de Janeiro and edited by C. H. Liberalli, who writes an introductory preface. The journal, which is published monthly, is divided into scientific and professional sections: articles in the first part include one by Prof. Costa on the biochemistry of zinc and another by Liberalli on the reaction of tartrates with the Mohler-Deniges reagent: gluconic, lactic and pyruvic acids also give a red-violet colour with the reagent, and bromine and iodine hinder its appearance, but permanganate and bichromate in small amounts do not interfere. The journal also contains abstracts from current literature.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant (Grade III) for research on internal combustion engines in the Royal Aircraft Establishment, South Farnborough, Hants (Dec. 13).

A lecturer in electrical engineering in the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (Dec. 16).

A director of sponge fisheries investigations, and a biological and a chemical assistant—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 31).

A Lancashire-Spencer professor of physics in University College, Nottingham—The Registrar (Jan. 20).

A director of the Indian Lac Research Institute, Namkum, Ranchi—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Dec. 21).

A professor of physics in Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 917.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Isotopic Structure of Iridium

FROM an examination of the hyperfine structure of certain lines of the arc spectrum of iridium, Prof. B. Venkatesachar and L. Sibaiya[1] have recently concluded that iridium must have two isotopes, and give reasons for assuming the mass numbers to be 191 and 193. I have recently verified this conclusion by a direct mass-analysis of the iridium ions formed by a high-frequency spark between electrodes made of platinum–iridium alloy.

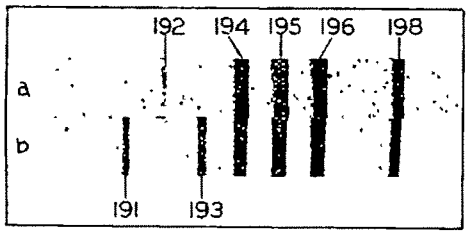

FIG. 1.

The analysis of the five platinum isotopes from an iridium-free electrode has been previously reported[2], and a print of one of these mass-spectra is reproduced in Fig. 1 (*a*). The centre lines are much over-exposed in order to bring out the very faint isotope at 192. When electrodes made of platinum–iridium alloy were used, two new lines appeared, as shown in Fig. 1 (*b*), indicating that iridium has two isotopes with mass numbers 191 and 193.

These two masses are the only gaps in the mass number scale in this region not occupied by osmium or platinum isotopes. No further isotopes would be expected from the rule followed by elements of odd atomic number. The heavier isotope at 193 is definitely stronger than the one at 191, thus giving a third exception, along with thallium and rhenium, to the rule that the lighter of a pair of isotopes of an odd numbered element is the more abundant.

A. J. DEMPSTER.

University of Chicago.
Oct. 30.

[1] Venkatesachar and Sibaiya, NATURE, 136, 437; 1935.
[2] A. J. Dempster, NATURE, 135, 993; 1935.

Thermal Decomposition of Certain Gaseous Organic Compounds

IN a letter in NATURE of March 30, I asked for suspension of judgment regarding a difference of opinion between Mr. Hinshelwood and his colleagues on one hand, and myself and my co-workers on the other, with regard to the possibility of measuring the rate of chemical reaction in the thermal decomposition of gaseous acetaldehyde by observing the rate of increase of pressure at constant volume, and also as to the mechanism of the chemical process involved. Mr. Hinshelwood has published an account of his latest work on this subject, and Mr. R. V. Seddon and I have carried on our own work to a point at which publication is possible. We believe that our results support our views on the case.

In the thermal decomposition both of ethylene oxide and of acetaldehyde the main reaction is represented by the equation, $C_2H_4O = CH_4 + CO$. The reaction can only be followed accurately by observing the rate of formation of methane, for in each case the main reaction is accompanied by secondary reactions which do not yield methane. Unless the rates of these reactions are also known, the results of observations of increase in pressure cannot be interpreted.

In the case of acetaldehyde, there is a secondary reaction which leads, through the aldol condensation, to propylene, and the propylene undergoes condensation. The formation of propylene is certainly a wall reaction; for if, for example, the surface area is increased five times, the rate of formation of propylene is increased four times, and the rate of the main reaction is decreased to one half. The main reaction, and the process leading to the formation of propylene, result, individually, in increase of pressure in the system, and if the rate of one falls off, the increase in the rate of the other may balance it. The condensation process involves a decrease in volume; so that increase in the rate of formation of propylene, by packing a reaction tube, may have the result that the final volume of the system, at an apparent end point, is less when the tube is packed, than when the tube is empty. Thus all the results obtained by Mr. Hinshelwood and his colleagues are fully accounted for, and also the fact that, by relying on pressure measurements as a means of following the course of the main reaction, they have missed the fundamental fact that increase in surface materially decreases the rate of it.

When the rate of the main reaction is followed by means of the analytical method which has been fully described elsewhere, by measuring the rate of formation of methane, it is observed that in neither case does the rate of reaction diminish with time, as the classical theory demands. In the case of acetaldehyde it either increases slightly at first, or remains constant; but in the case of ethylene oxide, there is a marked induction period, during which the rate of reaction increases very quickly. In both cases, when the reaction has proceeded for a time, it suddenly slows down, and then again accelerates, continuing at a rate slower than the initial rate. The phenomenon is similar to that attributed by Mr. Hinshelwood to the existence of acetaldehyde molecules in different states of activation. However, the pressure measurement method does not reveal the exact nature of the phenomenon, since the rate graphs are not segmented,

but may rather be described as being looped, since the sudden reduction in the rate seems always to be followed by a rapid recovery.

It will now be clear that phenomena, which are generally accepted as criteria of chain mechanism, are observed in both cases. In the case of acetaldehyde, the initial rate of decomposition is considerable, and we must suppose that the main process is carried forward both by the formation of new primary centres, and to a very material extent by chain mechanism. In the case of ethylene oxide, the rate of formation of primary centres is obviously very small, and the main process is carried forward mainly through the operation of the chain mechanism. In this case, surface does not influence the rate of the main reaction.

In both cases the secondary process conforms to the main reaction, and when breaks occur in the graphs representing the latter, they also appear simultaneously in the graphs representing the former. It would appear therefore that the *breaking of chains*, at the walls or in the gas phase, does not merely involve the dispersal of energy, but also the formation of new primary centres, of the kind referred to by Semenoff as *degenerate*, from which the secondary process originates. Three-body collision must obviously play an important part in these processes.

We have made a further study of the influence of neutral gases, such as hydrogen and methane, on the rates of reaction. The phenomena are much more complex than was indicated by our first experiments. The work is being continued, and will, we hope, throw light on the phenomena associated with the breaks in the rate graphs.

This work, and investigation carried out with Mr. P. F. Gay on the thermal decomposition of dimethylether into methane and formaldehyde, and other similar experiments, seem to be leading definitely to the conclusion that in all spontaneously occurring processes of this kind, the probability that the process will be continued by a chain mechanism is never zero. Semenoff has referred to the free energy of the process as giving a measure of the probability of the continuation of the process by chain mechanism. The term 'free energy' can only be used qualitatively, but so far as our work goes the principle seems to be well established.

MORRIS W. TRAVERS.

Chemistry Department,
University, Bristol.
Nov. 16.

Initial Formation of Methyl Alcohol in the Oxidation of Methane

ALTHOUGH a paper published about a year ago from our research laboratories, by Dr. D. M. Newitt and Mr. P. Z. Szego[1], described experiments in which large yields (up to 50 per cent of the theoretical) of methyl alcohol had been obtained by the slow reaction of methane–air mixtures at 430° and 50 atmospheres pressure, up to then no direct evidence had been obtained of its formation during the slow combustion of methane at atmospheric pressure.

Since then, however, further experiments by Dr. Newitt and Mr. J. B. Gardner have resulted in the isolation of methyl alcohol from the reaction products of a $2CH_4 + O_2$ mixture at 450° and atmospheric pressure, in contact with a porcelain surface, proof also being forthcoming of its formation preceding that of formaldehyde.

Such result led Dr. J. Bell to repeat some former experiments upon the explosions of a $5CH_4 + 2O_2$ mixture at initial pressure of about 50 atmospheres in a bomb (1 litre capacity), so arranged that the burning medium would be suddenly cooled by expansion after bursting a disc at a point (320 atmospheres) during the actual combustion period short of the maximum pressure of 430 atm., and that the cooled products would be retained in a large expansion chamber for subsequent analysis. Later examination of the suddenly cooled products has proved the presence therein of about 0·13 per cent of methyl alcohol and 0·03 per cent of formaldehyde, the alcohol having been isolated and identified as methyl 3 : 5 dinitro benzoate, m.p. 107·5°.

In none of the experiments referred to could even the faintest sign of 'peroxide' formation be detected.

WILLIAM A. BONE.

Imperial College of Science
and Technology,
London.
Nov. 22.

[1] *Proc. Roy. Soc.*, A, 147, 555; 1934.

Radioactivity of Oil-Waters in Czechoslovakia

PROF. V. J. VERNADSKY has directed attention to the investigations of Chlopin, Kurbatov[1] and other Russian scientific workers on the radium and mesothorium content of the brine of the Russian oil districts. In general, the radium content was found to be much higher than the normal content of surface waters (10^{-15} gm. radium per gm. water). The maximum was found in the water of the oil beds of Novyj Groznyj in the Northern Caucasus, with $1{\cdot}46 \times 10^{-10}$ gm. radium per gm. water. In several places the mesothorium content was likewise considerably higher, though there were scarcely any traces of thorium.

Later, O. Hahn and H. J. Born[2] put forward the view that the high radium content of the waters of the oil beds would account for the occurrence of helium in sylvine, as the alkali chlorides form mixed crystals with lead. During its secondary formation, the sylvine might therefore receive the isotope of lead, radium D, from underground waters rich in radium.

In connexion with these questions and also to ascertain how far the higher radium content of the oil-waters depends upon the kind of oil and the place of its occurrence, a preliminary survey has been made of the radium content of the brine of two oil beds in Czechoslovakia, at Gbely (Slovakia) and at Jasina (Carpathian Ruthenia).

Technically important occurrences of naphtha and natural gas are found in Czechoslovakia only in the Carpathian system. Compared with the other Carpathian countries—Poland and Rumania—the naphtha resources of the country are at present neither so important nor so well explored (Fig. 1). We find here two types of naphtha beds: beds of a light paraffinic naphtha limited to the Carpathian flysh belt (Cretaceous and Palæogene beds), and beds of a heavy naphtha without paraffin and without asphalt, of the naphthenic series, occurring in the Neogene of the Vienna basin. Light naphtha is met with in Moravia at Bohuslavice nad Vlárou and at Ratiškovice, in Western Slovakia at Turzovka and at Popradné in the Trenčín district, in Eastern Slovakia at Komárník na Dukle, at Miková,

Krivá Olka and Radváň near Medzilaborce, in Carpathian Ruthenia at Luhy in the Užok Pass and at Jasina. Heavy naphtha forms far more important beds and it is extracted from the Sarmatian Cerithian beds at the State mines at Gbely in Slovakia and at the mines of the Moravian Company at Hodonín in Moravia. At Gbely exploitation began in 1914 shortly after the occurrence of naphtha had been discovered by chance.

The naphtha-bearing area has been explored since then by nearly four hundred borings, hand-borings as well as exploitation- and deep-borings. At Gbely, naphtha is exploited in two fields, in the so-called "old field" and in the new field opened up in 1929. There are two naphtha horizons in the Sarmatian beds, which are covered by the younger Congerian beds of the so-called Pontian. Quaternary sediments are well represented (diluvial gravel and sand, loess, river deposits and quicksand). Several deep borings go down through the Sarmatian into the Second and First Mediterranean, the deep borings H_2 and H_6, with a depth of 986 metres and 1,420 metres respectively, going down even to the Palæogene. (For details of the geological structure, see, for example, L. Sommermeier, "Erdolgeologie der Tschechoslovakei", Hofer, "Das Erdol", second edition.) In the experimental measurements of the radioactivity of the waters at Gbely, we studied samples taken from the water horizons in the diluvial, Pontian, Sarmatian and Mediterranean beds. Some of them are characterised by a fairly high content of iodine.

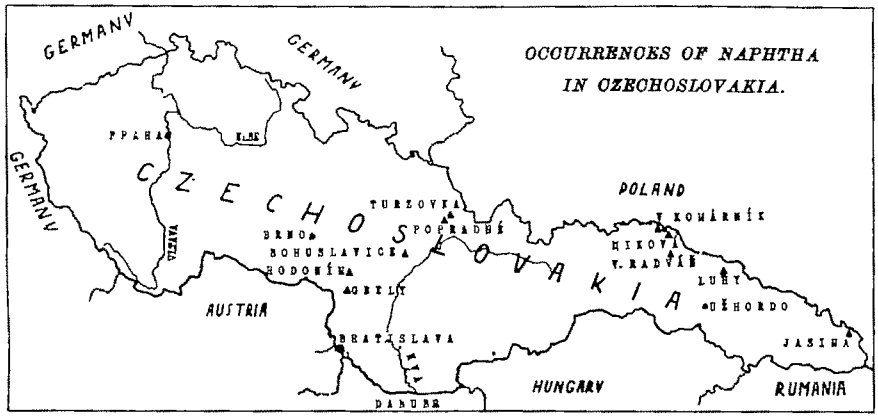

FIG 1.

One of the samples from Jasina-Stebná examined with regard to its radioactivity came from a depth of 779–786 metres, from the experimental boring No. 1. This occurrence, which was studied last century to some extent by forty not very deep borings, when it yielded a small quantity of light naphtha, is situated in the Palæogene flysh beds. These beds are composed of variegated clays and sandstones of the lower Eocene and of slaty marls of the upper Eocene (the so-called upper hieroglyphic layers) and of menilitic slates and sandstones of the Oligocene.

The radium content was determined by measuring the emanation. The coefficient of repartition of the emanation was determined for oil waters and air. This coefficient does not differ much from the coefficient generally given for water (0·25 at a temperature of 20° C.).

The radium content of thirty samples from different borings at Gbely and one sample from a boring at Jasina (Carpathian Ruthenia) was determined. The samples of water came from different horizons and different depths (between 8·7 m. and 521 m.). The highest content of radium found was $7 \cdot 25 \times 10^{-10}$ gm. in one litre of water (the water from the horizon at a depth of 262 m.). Only eight samples of water had a radium content of the order of 10^{-10}, the others being of the order 10^{-12}–10^{-11}. No distinct correlation between the depth of the horizon and the radioactivity of the corresponding oil-water could be established; even from the greatest depths, activities of the order of 10^{-12} were established. From the experimental boring at Jasina the water from the horizon at 779–786 m. was examined with regard to its contents in radium; and it was found to be no higher than that of the waters from Gbely ($3 \cdot 8 \times 10^{-10}$ gm. in one litre). Waters from other borings at Jasina are also to be examined with regard to their radioactivity.

With turbid and polluted waters, the muddy particles were separated by filtration and the radium content was measured separately in the filtrate, but without obtaining any abnormally high values. An experiment was made by the Elster-Geitel method with the residue by evaporation from waters with radium content of the order 10^{-10} in one litre, so as to ascertain the nature of the radioactive elements the water contains. The presence of elements of the thorium series could not be proved. The content of radium elements is therefore much lower in the oil-waters of Czechoslovakia than in those of Russia.

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[1] V. Vernadsky, *C.R.*, 190, 1172; 1930. V. Chlopin and V. Vernadsky, *Z. Elektrochem.*, 38, 527; 1932.
[2] O. Hahn and H. J. Born, *Naturwissen.*, 22, 188; 1934.

Recoil by β-Decay

IF one investigates the recoil of a light nucleus by emission of an electron and a neutrino, it is important to consider that for a given direction of the electron the angular distribution of the neutrino is not isotropic. The details of the β-decay naturally depend on the assumptions made about the interaction between the heavy particle and the electron-neutrino field; in particular, they determine the energy distribution of the electron. But even if this distribution were known, apart from any theory, the recoil would still depend on the special form of the interaction energy, in so far as this form also determines the coupling between the directions of electron and neutrino. Such a coupling is a general consequence

of the theory of β-decay, although the wave-lengths have to be assumed to be large compared with the nuclear dimensions. In the case of the two forms of interaction proposed by Fermi[1] and Konopinski and Uhlenbeck[2] of the type (0,0) and (0,1) respectively[3], the coupling is due to the fact that the four amplitudes of the wave-functions depend on the direction of the particles. For the type (1,1) as well as in the case of higher derivatives, the coupling appears explicitly in the interaction energy.

For a given velocity v of the electron, the probability that it will be emitted within the solid angle $d\Omega$ under an angle δ against the direction of the neutrino, is in the three cases mentioned given by:

$$(0,0) : (1 + \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi}$$

$$(0,1) : (1 - \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi}$$

$$(1,1) : (1 - \frac{v^2}{c^2} \cos^2 \delta) (1 - \frac{v}{c} \cos \delta) \frac{d\Omega}{4\pi (1 - v^2/3c^2)}$$

Here we have neglected the Coulomb interaction between the nucleus and the electron; this is justifiable for small atomic numbers. Since for (0,0) (0,1) (1,1) it is most likely that the two particles will be emitted parallel, opposite or perpendicular to each other respectively, the recoil distribution will depend on which of the proposed forms of the interaction energy has to be accepted. Experiments on the β-recoil might thus enable a decision to be made between the alternatives.

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København.
Oct. 26.

[1] E. Fermi, *Z. Phys.*, 88, 161; 1934.
[2] *Phys. Rev.*, 48, 7, 1935.
[3] For the different possible forms and our notation, see E. J. Konopinski and G. E. Uhlenbeck, *Phys. Rev.*, 48, 107; 1935.

Electrolytic Separation of the Oxygen Isotopes

WASHBURN and Urey[1] first directed attention to the fact that fractionation of the isotopes of oxygen occurs simultaneously with that of the hydrogen isotopes during the electrolysis of water. The electrolytic separation coefficient α for the oxygen isotopes has been determined in a series of experiments carried out in the Research Laboratories of Imperial Chemical Industries, Ltd., and was found to be 0·87 when using nickel electrodes and 1·25*N* NaOH as the electrolyte. This value is in good agreement with that of $\alpha = 0{\cdot}85$ calculated from the results of Washburn, Smith and Smith[2] who used nickel-plated cast iron electrodes—the electrolyte being 5*N* NaOH.

A sample of pure D_2O has recently been prepared, in which the oxygen isotope ratio has been adjusted to its normal value[3]. The density was found to be $d^{25°}_{25°} = 1{\cdot}1074$, which is lower than the value previously cited[4] of $d^{25°}_{25°} = 1{\cdot}1079$. If the difference is ascribed to concentration of oxygen isotope during the process of electrolysis, then it is possible to calculate an approximate value for the oxygen isotope separation coefficient α, and this is found to be 0·84. The separation coefficient probably depends to a certain extent on the electrode material and the nature of the electrolyte, for Johnston[5], using iron electrodes and caustic potash solution as the electrolyte, obtains a value of α of $0{\cdot}992 \pm 0{\cdot}003$.

It is possible to arrive at a theoretical value for α if the assumption is made that whatever the mechanism of electrolysis, the rate-determining step is the passage of a $O^{18}H$ or $O^{16}H$ complex over or through an energy barrier. Previously, it has been assumed that the possibility of 'tunnelling' by particles of mass greater than 2 would be so small as to be negligible. Actually, it can be shown using a modification of the method applied by Ogden and Bawn[6] to the hydrogen isotopes, that there is a small but quite definite probability for the 'tunnelling' of energy barriers by complexes such as $O^{16}H$ and $O^{18}H$. From these considerations it can be shown that α has values lying between 0·86 and 1, depending on the width and height of the energy barrier.

Taking the most favourable value for α, the oxygen isotope O^{18} concentration in pure D_2O, prepared by electrolytic methods, can never be more than about 0·6 per cent, that is, while the concentration of deuterium increases from about 1/5,500 to 100 per cent, the oxygen isotope concentration only increases from 0·15 per cent to 0·6 per cent.

I am indebted to the directors of Imperial Chemical Industries, Ltd., for permission to publish this note.

GEOFFREY OGDEN.

Imperial Chemical Industries,
Billingham-on-Tees.
Oct. 25.

[1] *Proc. Nat. Acad. Sci.*, 18, 496; 1932.
[2] *Bur. Stand. J. Res.*, 13, 599; 1934.
[3] Tronstad, Nordhagen and Brun, NATURE, 136, 515, Sept. 28, 1935.
[4] Selwood and Taylor, *J. Amer. Chem. Soc.*, 56, 998; 1934.
[5] Johnston, *J. Amer. Chem. Soc.*, 57, 484; 1935.
[6] Ogden and Bawn, *Trans. Far. Soc.*, 30, 432; 1934.

Chemistry of Œstrogenic Substances

WE have reported that we were unable to obtain any evidence of œstrogenic activity in rats with benzylidenepyruvic acid and furylidenepyruvic acid or their sodium salts[1]. These negative results were attributed by Friedmann[2] to the use of insufficient doses (100 mgm. per rat), and to an unsuitable spacing of the doses. Friedmann predicted that 240 mgm. of dry sodium salts would be sufficient to produce œstrus in rats, and claimed to have obtained œstrus in mice with 24 mgm., injected in three doses at intervals of 24 hours.

We have carried out further experiments using both rats and mice. Five ovariectomised rats, which had been shown to respond normally to œstrone, were each given subcutaneous injections of 300 mgm. of sodium benzylidenepyruvate dissolved in 3 c.c. of water, the injections being spaced over three days. Three rats died on the third day of the test, one on the fourth day, and neither these nor the surviving rat showed any sign of œstrus.

The mice used in our tests were pure strain 'Simpson' mice, all of which, after castration, gave a full œstrous response with 0·2γ of œstrone. Ten mice were injected with sodium benzylidenepyruvate, and ten with sodium furylidenepyruvate. Each animal received three subcutaneous injections, at 24-hour intervals, of 8 mgm. of the sodium salt, dissolved in 0·25 c.c. of normal saline. Thus, the total dose was 24 mgm. per mouse. Vaginal smears were examined twice a day for 72 hours following the last injection, and then daily for four days. Although the injections produced considerable

necrosis, 18 mice survived the whole experiment (9 in the case of each compound), and none of these showed the slightest suggestion of œstrous response.

These results give no support to Friedmann's claim that the compounds in question have œstrogenic properties.

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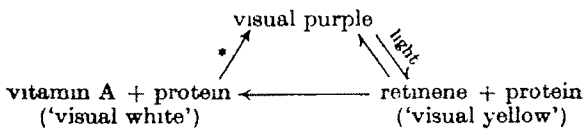
[1] J. W. Cook and E. C. Dodds, NATURE, 135, 959; 1935.
[2] E. Friedmann, NATURE, 136, 108; 1935.

The Visual Purple System in Marine Fishes

I HAVE recently examined the eye tissues of the sea robin (*Prionotus carolinus*), the black sea bass (*Centropristes striatus*), and the porgy or scup (*Stenotomus chrysops*). The visual purple system in these animals is identical chemically with that in frogs[1]. It is described partly by the equations:



All of these reactions but the one starred occur in the isolated retina as well as in the intact eye.

The results of an experiment with scup retinas, typical for the other forms also, are shown in Fig. 1. Right and left retinas of five dark-adapted scup were prepared separately. One set of five retinas was extracted thoroughly in the dark with benzine. The extract, tested with antimony trichloride reagent, yielded a blue colour of which the lower curve is the absorption spectrum. The dark adapted retina contains a small quantity of vitamin A alone (615 mμ chromogen).

The same retinas were bleached to an orange colour ('visual yellow') in bright light, and immediately re-extracted with benzine. The extract, tested as before, yielded the upper left curve. Light, in bleaching the visual purple to yellow, liberates a large quantity of retinene (664 mμ chromogen).

The second set of five retinas was bleached and left for an hour at room temperature before being extracted with benzine. During this period the visual yellow faded to colourlessness ('visual white'). The extract yielded the upper right curve of the figure. Retinene liberated by light is eventually converted quantitatively to vitamin A.

Kottgen and Abelsdorff[2] found the absorption spectrum of visual purple from eight species of fresh-water fishes to have a maximum at about 540 mμ; while that from amphibia, owls and mammals was of the same general form, but displaced so that the maximum occurred at about 500 mμ. This spectral peculiarity, if general, might have made an examination of fish retinal processes of special interest. However, the absorption spectra of visual purple from the species used in the present experiments are practically identical with that from frogs, the maxima falling in every case at about 500 mμ. The nature of the possible disagreement between these and previous data[2] is being investigated.

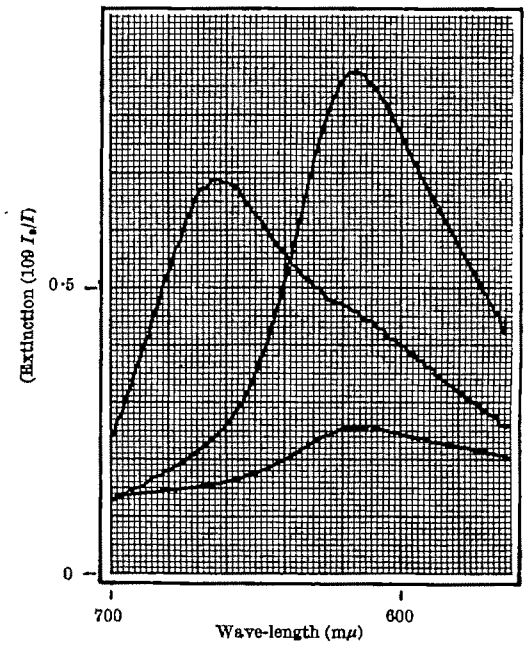


FIG. 1. Spectra of antimony chloride reactions with scup retinas, recorded automatically with a photo-electric spectrophotometer at the Massachusetts Institute of Technology (Hardy, A. C., *J. Opt. Soc. Amer.*, 25, 305; 1935).

The combined pigment epithelium and choroid layer of these eyes contain vitamin A, an unidentified xanthophyll and flavine.

Details of this work will appear in the *Journal of General Physiology*.

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[1] G. Wald, NATURE, 134, 65; 1934; 136, 832, Nov. 23, 1935; *J. Gen. Physiol.*, 19, 1935-36, in press.
[2] E. Kottgen and G. Abelsdorff, *Z. Psych.*, 12, 161; 1896.

Oxidative Inactivation of Co-zymase with Schardinger Enzyme Preparations

IN continuation of experiments showing that a reversible oxidative inactivation of glycolysis or fermentation (Pasteur reaction) may take place[1], the action of Schardinger enzyme (xanthine oxidase) on fermentation was tried. Schardinger enzyme was prepared from milk by the method described by M. Dixon and Kodama[2] or that due to Toyama[3]. In a mixture of such a milk preparation and yeast macerate (Lebedew) a considerable inhibition of fermentation appears after shaking with oxygen for about 1–1½ hours. In the absence of oxygen, no appreciable inhibition appears in this time.

Fig. 1 shows the results of an experiment in which, before the addition of glucose, the mixture was shaken for 1½ hours with oxygen and nitrogen

respectively. Removal of the oxygen did not restore fermentation. Fermentation recommenced, however, upon addition of a small amount of boiled yeast macerate, or of highly purified co-zymase, for which I am indebted to Prof. von Euler. The oxidation of the nucleotide part of the co-zymase seems very improbable, because Dixon and Lemberg[4] have shown that nucleotides, and also crude co-zymase preparations, are attacked by xanthine oxidase only after hydrolysis by an enzyme contained in the milk

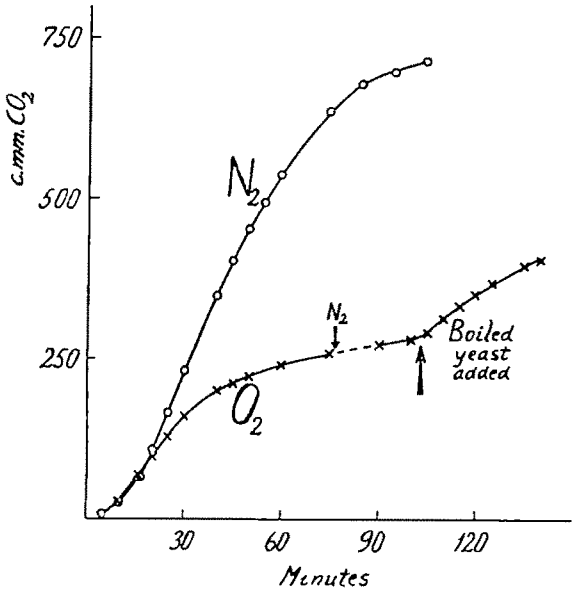

FIG. 1.

preparations. Although the real nature of the oxidative inactivation of co-zymase is not clear, the catalysis of the process by an enzymatic system appears to be of interest in connexion with the mechanism of the Pasteur reaction.

The present report of results, in this stage, is due to the very recent appearance of a publication by B. Andersson[5] from Prof. von Euler's laboratory, also dealing with the action of Schardinger enzyme on co-zymase.

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Carlsberg Foundation,
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[1] F. Lipmann, *Biochem. Z.*, 265, 133; 1933. 268, 205, 274, 412; 1934.
[2] M. Dixon and K. Kodama, *Biochem. J.*, 20, 1104; 1926.
[3] I. Toyama, *J. Biochem.*, 17, 131; 1933.
[4] M. Dixon and Lemberg, *Biochem J.*, 28, 2065; 1934.
[5] B. Andersson, *Z. physiol. Chem.*, 235, 217; 1935.

Adsorption of Grass and Butter Carotenes on Alumina

WE have recently reported that the petrol-phasic carotenoid fraction of butter unsaponifiable matter, when subjected to chromatographic adsorption on alumina, separates readily into two coloured zones, the upper red-brown, the lower yellow[1]. The appearance and location of the zones, and the absorption spectra of the elutriated pigments, are consistent with the presence of appreciable quantities of α-carotene in butter. The α-isomer has since been independently detected in butter[2], using magnesium oxide as adsorbent.

A re-examination, however, of the adsorption of butter carotene on each of these two adsorbents shows that alumina gives an apparent α-carotene content much greater than does magnesium oxide.

In studying these anomalous results, we carried out adsorption experiments on pure β-carotene itself, the specimen used (*ex* cocksfoot grass; m.p. 180°–182°; rotation nil) being made available through the kindness of Prof. A. C. Chibnall. When this material is submitted to adsorption on alumina (Brockmann's, *ex* Merck, diluted 1 in 3 with inactive alumina), petroleum ether (b.p. 70°–80°) being used as solvent, the adsorbed pigment appears to be homogeneous. If, however, the carotene is washed off the adsorbent with petrol (or elutriated with methyl alcohol), recovered, and readsorbed, it separates clearly into two zones of pigment, the absorption maxima of which, on elutriation, are as follows:

Upper zone	483	452 mμ	in petroleum ether (b.p. 70°–80°);
Lower zone	477	447 mμ	

that is, identical with those of β- and α-carotene respectively. The lower zone thus contains a pigment formed during the adsorption process, and moreover, elutriation and readsorption of *either* of the two zones gives another separation into two zones with properties as before, on each subsequent adsorption, the process thus being reversible and never complete.

Calcium hydroxide, which separates α- and β-carotenes[3], also converts pure β-carotene into this yellow substance, but not so readily as does alumina. Magnesium oxide, also used for separating α- and β-carotenes[4], gives no evidence of separation of pure β-carotene into two zones even after four adsorptions. Further, carotene made separable by alumina or calcium hydroxide adsorption is apparently homogeneous when adsorbed on magnesium oxide.

The change has been obtained with pure crystalline β-carotene from both grass and carrots and also with the petrol-phasic carotenoid fractions of butter[1] and blood serum[5]. In the last two cases the pigment separated readily with one adsorption, whilst with the purified pigments a preliminary adsorption was necessary before the separation was evident.

Genuine α-carotene *ex* palm oil[6] has also been examined. Repeated adsorption on alumina changes this pigment also, giving two zones which, on elutriation, exhibit absorption maxima as follows:

Upper zone (α-carotene ?)	477	447·5 mμ	in petrol (b.p. 70°–80°).
Lower zone	469	440 mμ	

This second substance on readsorption suffers partial reversion, again giving two zones of pigment with absorption maxima as just stated. The absorption maxima characteristic of the lower zone are closely comparable with those already reported, for a yellow substance occurring in small quantity at the bottom of the column, when α- and β-carotene mixtures are adsorbed on calcium hydroxide[3].

It might appear that on repeated adsorption β-carotene undergoes a *reversible* change into the α form, but the observation that genuine α-carotene changes into a substance with absorption maxima at shorter instead of longer wave-lengths makes this unlikely.

Whatever the explanation of the foregoing observations, which we are now investigating further, it is

clear that, *following the usual procedure* for the chromatographic technique, carotene undergoes change into another pigment when repeatedly adsorbed on alumina, even when oxygen is rigorously excluded.

In view of the widespread and successful use of chromatographic methods[7] in the carotenoid field, it is important that the possibility should be recognised that changes can occasionally be brought about by the process itself.

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M. S. EL RIDI.

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Nov. 5.

[1] Gillam and Heilbron, *Biochem J.*, **29**, 834; 1935.
[2] Strain, *J. Biol Chem.*, **111**, 85; 1935.
[3] Karrer and Walker, *Helv. Chim. Acta*, **16**, 641; 1933.
[4] Strain, *J. Biol. Chem.*, **105**, 525; 1934.
[5] Gillam and El Ridi, *Biochem J.* (in press).
[6] Kuhn and Brockmann, *Z. physiol. Chem.*, **200**, 255; 1931
[7] Kuhn and Brockmann, *Z. physiol. Chem.*, **206**, 41; 1932. Cf. also Winterstein, "Klein's Handbuch der Pflanzen-Analyse", 4, 1403; 1933.

Plasticity of Bismuth

IN an earlier letter[1] one of us (W. F. B.) tried to explain the discrepancies which exist concerning the plasticity of bismuth. It was confirmed that crystals obtained by different methods behave quite differently; for example, that soft crystals, that is, crystals which slip in tensile tests at room temperature, occur among those made in air (Czochralski method), whereas only hard crystals are obtained *in vacuo* (Bridgman method). Since the crystals made under atmospheric pressure were found to contain some gas, it was suggested that the gas was responsible for their softness. Hard crystals made *in vacuo* were found to slip in compression tests at room temperature and in tensile tests at higher temperatures[2]. Experiments by Gough[3] and by Andrade and Roscoe[4] seem to support these findings.

Since the difference mentioned above is not the only one in making the crystals, it was desirable to apply a method which would allow the crystals to be grown *in vacuo* or under pressure while keeping all other factors constant. A method devised by Andrade and Roscoe[4] has been found suitable for this purpose. In it a furnace travels horizontally along a wide glass tube, in which lies a thin piece of wire to be made into a single crystal. The glass tube can be evacuated or filled with gas. By this method it is easy to get crystals of any desired orientation by using a seed crystal.

The wires used were 1–2 mm. in diameter and were obtained by casting *in vacuo*, to be sure that they were free of gas. The material was (1) that used in the earlier experiments, (2) Hilger's spectroscopically pure Bi No. 9506, the same material, we understand, as used by Andrade and Roscoe[5]. Crystals were grown from (1) *in vacuo*, and in nitrogen, hydrogen, carbon dioxide; from (2) *in vacuo* only. The rate of growth was 1·6 mm./min.

Under all conditions some of the crystals obtained were soft. So far as the experiments on crystals grown under atmospheric pressure are concerned, these results are a qualitative confirmation of those of Georgieff and Schmid[6], since their crystals, obtained by the Czochralski method, contained gas. We consider the fact that crystals grown *in vacuo* show a similar behaviour, goes beyond their results, and it also seems at variance with the results of Andrade and Roscoe[5]. It remains to be seen whether the conformity of the crystals grown in gas and *in vacuo* is a quantitative one. We believe that the crystals made in vacuum exhibit the 'true behaviour' of bismuth, because the Andrade method seems the least objectionable of all. Any hard crystals found could be explained by unsuitable orientation[6]. Thus the gas content seems to have little influence, and another explanation has to be found to show why bismuth crystals grown by Bridgman's method are hard. Here the material is cast into glass tubes and remains there while solidifying. Owing to the well-known anomalous behaviour of bismuth, it seems possible that it becomes subject to heavy stresses from the surrounding glass while cooling under such conditions. We have confirmed the fact, already stated by Gough and Cox[7], that one seldom finds a bismuth crystal obtained by this method which does not show mechanical twinning. It thus appears likely that the hardness of such crystals is but another example of strain hardening.

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L. SANDLER.

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University,
Manchester.
Oct. 17.

[1] NATURE, **133**, 831; 1934.
[2] NATURE, **134**, 143; 1934.
[3] Proc. International Conference on Physics, **2**, 180; 1934.
[4] Ibid., **2**, 176.
[5] Ibid., **2**, 176.
[6] *Z. Phys.*, **36**, 759, 1926
[7] *J. Inst. Metals*, **48**, 227; 1932.

DR. BERG has invited me to comment in print upon an earlier version of the above letter. In view of the somewhat contradictory nature of the findings communicated in his last two letters on the subject, I think that any attempt to estimate how far he has gone beyond Georgieff and Schmid may well await his final results, which will, no doubt, be shortly published with due circumstance in one of the technical journals. I have been unsuccessful in a private attempt to make Dr. Berg understand what I consider to be the significance of our results on bismuth, and I do not think that it would be profitable to renew the attempt in public. The letter does, however, contain one fact, previously unknown to me, which I note with interest, namely, that Dr. Berg has found useful our technique for growing strain-free single crystals*, which we had the pleasure of demonstrating to him in detail when he paid a personal visit to our laboratory last year.

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* Unpublished, except for a three-line reference in "Proceedings of the International Conference on Physics", 1934, p. 173.

Coalescence in Stages between Two Drops of a Liquid

IN a letter in NATURE of August 3[1], Ian W. Wark and Alwyn B. Cox record their observation that "Small drops directed obliquely on to the surface of tap water do not immediately coalesce with it", and they suggest that the reason for this lies in the contamination of the surface by a thin film of grease or dust.

So far as one can see from this short description, the phenomenon seems to be identical with, or similar

to, that which I described a few years ago[2]. If a fine jet of water issuing from a fine nozzle with a moderate velocity reaches the surface of tap or distilled water in its instability range, it is resolved into many floating drops which last about three seconds. I noticed that the chief condition for the success of the experiment was the freshness and cleanness of the water used. Even the least trace of grease, for example, the very touch of the surface with the fingers, lessened the range and life of the drops, or even made success impossible. In so far as the same phenomenon is in question, the interpretation of the above-mentioned authors is opposed to these observations of mine.

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Oct. 16.

[1] I. W. Wark and A. B. Cox, NATURE, 136, 182, August 3, 1935.
[2] M. Katalinić, NATURE, 127, 627, April 25, 1931.

Cytoplasmic Bodies in the Oogenesis of *Lumbricus*

BY those[1] who have worked on the oogenesis of *Lumbricus* or allied forms, the vitellogenesis is believed to be one of the simplest known, though there is no general agreement.

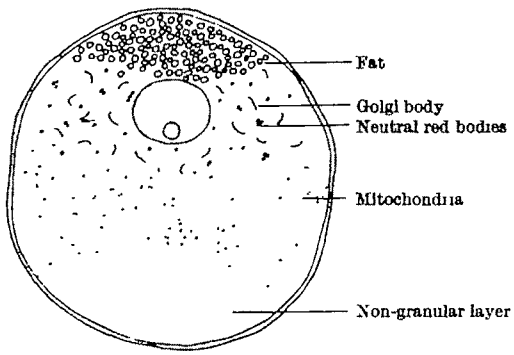

FIG. 1.

We have recently used the Beams' ultra-centrifuge on these eggs, and our findings are as follow. The cytoplasmic granules form a number of layers, consisting of fat granules above, Golgi elements below and in the region of the nucleus, mitochondria lower still, and the lowermost layer formed of a homogeneous and non-granular substance, as shown in the semi-diagrammatic reproduction (Fig. 1). The mitochondria are granular, not filamentous. No protein yolk could be found, and the larger granules to be seen so clearly in the living eggs are fat, not Golgi bodies; when previously stained supra-vitally in neutral red, before centrifuging, the globules so produced take up a position mainly between the fat and the mitochondria, that is the region where the dictyosomes of the Golgi apparatus come to lie.

GERTRUDE NORMINTON.
J. BRONTE GATENBY.

Dept. Zoology,
Trinity College, Dublin.
Nov. 2.

[1] Harvey, *Quart J. Micr. Sci.*, 74; 1931. Gatenby and Nath, *Quart. J Micr Sci.*, 70; 1926. Nath, *Quart. J. Micr. Sci.*, 73; 1930. Weiner, *Z. mikr. anat. Forsch.*, 20; 1930.

Age of the Universe

SIR JAMES JEANS has recently pointed out[1] that observations of binary stars indicate 10^{13} years as the order of age of the universe, while the recession of the nebulæ, indicated by their spectral shift, suggests an age of the order of 10^{10} years.

In a recent publication[2], however, we have shown how the spectral shifts may be accounted for by a variation with time of certain electrical and quantum quantities; this allows a way out of the difficulty. In order to measure times over long periods, one must define a standard for measuring time intervals at different epochs; such a standard might depend either on gravitational or electrical measurements, and the two systems, though by definition agreeing now, might differ in the results for a period of time in the past. Thus the age of the universe might well be 10^{13} years when measured in terms of a gravitational definition of the year, and at the same time 10^{10} years when measured in terms of an electrical definition of the year. The apparent discrepancy now becomes a way of determining the relative values of electrical and gravitational phenomena in the past.

J. A. CHALMERS.

The University,
Durham.

BRUCE CHALMERS.

Sir John Cass Technical Institute,
London.

[1] J. H. Jeans, NATURE, 136, 432, Sept 14, 1935.
[2] J. A. Chalmers and B. Chalmers, *Phil. Mag.*, 19, 436; 1935.

The Spectrum of γ Cassiopeiæ

ON and since October 7, a very strong and very sharp absorption line, the strongest and sharpest absorption line in the whole spectrum, suddenly appeared in the spectrum of γ Cassiopeiæ. This line is nearly coincident in position with that which should be occupied by the bright violet component of Hζ. On receiving this information, Prof. A. Fowler has suggested that it is probably the neutral line of helium (λ 3888·646) intensity 10, this line being the strongest line of the principal series of the triplet system. The next line in this series is at λ 3187·743 (intensity 8), but this falls outside the region photographed at Sidmouth, so its presence cannot be ascertained.

In view of the other important changes in the spectrum to which I have recently directed attention, the spectrum evidently needs careful watching for further variations.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,
Sidmouth.
Nov. 24.

Fossil Human Occipital Bone from Thames Gravels

UNDER "News and Views" in NATURE of October 19, page 638, the discovery at Swanscombe of a human skull fragment by Mr. Marsden is recorded and the note says, *inter alia*, "The bone was associated with Acheulean flint implements". We should like to put on record that in our experience the middle gravel of the 100-ft. terrace, in which the bone was found, contains, in addition to Acheulean hand-axes and flake tools, artefacts of Clacton III type closely resembling those of High Lodge, and also a few flakes exhibiting a Levalloisian technique.

Both of us have been privileged to examine the actual spot where the skull fragment was found, and we can record that at the horizon in question unabraided Clactonian flakes and tools are almost as common as Acheulean ones.

Dept. of Geology, British Museum (Nat. Hist.), S.W.7. K. P. OAKLEY.

University of London Club, 21 Gower Street, W.C.1. L. S. B. LEAKEY.

Recrystallisation accompanying an Allotropic Change

DR. W. G. BURGERS and Dr. van Amstel are to be congratulated on their success in obtaining a cinematograph record of the $\alpha \rightleftarrows \gamma$ change in iron by the very beautiful method they describe in NATURE of November 2 (136, 721). Their photographs show that recrystallisation at an allotropic change point is similar to that occurring on heating coldworked metal. Some years ago, in order to settle this same point, I examined a number of salts which undergo allotropic changes of a similar character. Ammonium, potassium and silver nitrates are particularly suitable as they can be melted on a slide and, if crossed Nicol prisms are used, the whole process can be studied. In every case the change began at the crystal boundaries or round an inclusion or blow-hole, by the appearance of new crystal nuclei which rapidly spread across the field. I then found that the rate of change could be slowed down by the presence of a cover-slip and by regulating the thickness of the fused salt, and obtained a series of photographs—some of them in colour—illustrating the change over.

C. F. ELAM.

Engineering Laboratories, Cambridge.

Points from Foregoing Letters

Mass spectrograms of platinum and platinum-iridium alloy obtained by means of a high-frequency spark are submitted by Prof. A. J. Dempster. They confirm the existence of two iridium isotopes of mass numbers 191 and 193, the existence of which was recently deduced by Venkatesachar and Sibaiya from the arc spectrum of iridium. These two isotopes fill the only gaps in the mass number scale in this region.

Prof. M. W. Travers discusses the processes involved in the thermal decomposition of acetaldehyde and of ethylene oxide, concerning the mechanism of which a divergence of opinion exists. Prof. Travers claims that additional experiments support his view that the reactions depend upon the surface of the system and that they involve a 'chain' mechanism.

The detection by Dr. J. Bell of small amounts of methyl alcohol (0·13 per cent) and of formaldehyde (0·03 per cent) in the suddenly cooled products of the explosion of a methane-oxygen mixture is reported by Prof. W. A. Bone.

The radioactivity of oil-waters from Czechoslovakia has been measured by Prof. F. Běhounek, V. Santholzer and Prof. F. Ulrich. The highest content of radium found is $7 \cdot 25 \times 10^{-10}$ gm. in one litre of water, from a depth of 262 metres. This is much lower than the radioactivity reported by Vernadsky from oil-waters in the Northern Caucasus ($1 \cdot 46 \times 10^{-7}$ gm. per litre).

In order to account for the production of electrons of different energies by radioactive elements, some physicists have been led to postulate the simultaneous emission of neutrinos, which are uncharged particles of mass comparable with that of the electron. Drs. F. Bloch and C. Møller discuss the probable relation between the direction of emission of the electron and that of the neutrino.

The electrolytic separation coefficient for the isotopes of oxygen is found by Geoffrey Ogden to lie between 0·86 and 1·0, depending on the width and height of the energy barrier, and taking into account the possibility of 'tunnelling' of the barrier by the $O^{16}H$ or $O^{18}H$ complex. This range of values is in good agreement with the available experimental results.

Further experiments on the chemical changes taking place in the retina, connected with the visual purple system, are reported by G. Wald. He finds that in the retina of fishes, as in that of frogs, the following cycle occurs: visual purple → retinene → vitamin A → visual purple.

In connexion with processes that may affect the glycogen → lactic acid fermentation (Pasteur reaction), Dr. F. Lipmann reports that an inhibition of fermentation takes place when yeast macerate is mixed with a milk preparation containing xanthine oxidase (Schardinger enzyme), in the presence of oxygen. Fermentation recommences upon addition of boiled yeast macerate or purified co-zymase.

A. E. Gillam and M. S. El Ridi present evidence to show that, when pure β-carotene from grass is twice adsorbed on alumina, it changes partially into a substance similar to α-carotene. The process is reversible, as this substance on readsorption reverts in part to the original β form. Genuine α-carotene is also changed under these conditions, and it is therefore important to recognise that surface adsorption can itself change certain pigments as well as separate them (chromatographic adsorption).

Applying the method of Andrade and Roscoe for growing metal crystals under atmospheric pressure or *in vacuo*, leaving all other factors constant, Dr. W. F. Berg and L. Sandler show that bismuth crystals, which slip in tensile tests at room temperature, can be obtained in gas and *in vacuo*. The hypothesis that gas was responsible for the softness of bismuth crystals, put forward by Dr. Berg in an earlier letter, is now withdrawn. The hardness of bismuth crystals obtained by Bridgman's method is tentatively explained as strain hardening.

A diagram showing the order in which the various constituents of the egg of the earthworm (*Lumbricus*) arrange themselves under the influence of a strong centrifugal force is given by Miss Gertrude Normington and Prof. J. Brontë Gatenby. No protein yolk could be found, though yolk formation is believed by some to be one of the simplest of life processes.

Dr. J. A. and Mr. B. Chalmers claim that the discrepancy between the age of the universe deduced from the 'reddening' of the light from nebulæ (10^{10} years) and that computed from observations of binary stars (which indicate a period a thousand times greater) may be simply explained by a change in the time standard at different epochs, since the standard may depend upon gravitational and electrical factors.

Research Items

Alaskan Archæology

DR. ALEŠ HRDLIČKA, the Smithsonian Institution of Washington, D.C., reports, has recently returned from his fourth successive season of excavation on a habitation site on Kodiak Island, off the coast of Alaska. He is more than ever convinced that this is one of the key sites of North American archæology. It covers four acres, and in places the deposits are more than sixteen feet in depth. At least one more season is required to complete the excavation; and judging from the manner in which new and disturbing factors have occurred unexpectedly in the exploration of previous years, Dr. Hrdlička regards it as unsafe at present to draw anything but the most tentative conclusions in the interpretation of the evidence. As the result, however, of a personal examination of the prehistoric evidence from British Columbia, he is convinced that the peoples of Kodiak and the British Columbia coastal area are identical in physique and culture. The Kodiak culture in its earliest phase is dated at approximately two thousand years ago. Only shortly before did the island become inhabitable, owing to the shrinkage of glaciers. The glacial period was followed by a deposit of loess on the glacial till, and it was on this loess that the first settlement took place. The first settlement was of brief duration, the people possibly migrating to the north-west coast. A further deposit of four or five inches of loess was succeeded by a period of pluviation, which covered the island with vegetation; and from this time forward, it was inhabited continuously until about the time of the coming of the Russians, when it was abandoned. For about the last fifth of this occupation the island was inhabited by people of Aleut type who had massacred the older inhabitants. In all the periods of the older occupation there was a relatively high type of culture, the oldest being in some respects the most advanced. It was in this earliest period that carving in wood, bone and ivory flourished, most characteristic being a realistic form of portraiture, in which one specimen shows the feature, rare among North American indigenes, of a chin beard.

Elasmobranchs from Puget Sound

WHILST collecting on the shrimp trawler *Audrey*, Allan C. DeLacy and Wilbert M. Chapman captured some interesting adult elasmobranchs and egg-cases (*Copeia*, No. 2, 1935). Egg-cases of *Apristurus brunneus* were taken from the female, and others were found attached by their tendrils to a sea-whip, *Stylatula*. The adult is little known, but twenty-two specimens were taken by the *Audrey* in Saratoga Passage and along the east side of Camano Island. Other egg-cases described are those of *Raja rhina*, taken abundantly off Everett and a few from the San Juan Islands, and *Raja binoculata* from the latter locality, taken commonly throughout the summer. Two young skates of *R. binoculata* measured shortly after they had hatched from an egg-case in an aquarium were 194 mm. and 197 mm. in total length respectively. Egg-cases of the ratfish, *Hydrolagus colliei*, were also common, the length ranging from 114 mm. to 140 mm. A tendril 120 mm. long was seen on one freshly deposited case. The cases were always empty, or contained undeveloped eggs. In one instance, the trawl brought up a female ratfish to which the egg-cases were still attached by their long anterior filament. Embryos of *Squalus neckleyi* were examined, and here the eggs in the Müllerian duct are enclosed in a long tubular case, transparent, flexible and entirely smooth, which ends in a single horn bearing a tendril which in one specimen was 70 mm. long. When the embryos have developed to a size not exactly known, the egg-case is resorbed or sloughed off, and the embryos continue their development in the Mullerian duct, which is abundantly supplied with large blood vessels and has, dependent from the inner side, innumerable small platelets also liberally supplied with blood vessels. When the yolk has been completely absorbed, the young dogfish are born alive. 1-4 eggs may be enclosed in one case.

Japanese Freshwater Cladocera

DR. MASUZO UÉNO, following his first paper (1927, in the same periodical), continues his study of the freshwater Branchiopoda of Japan in three further papers (*Mem. Coll. Sci., Kyoto Imp. Univ.*, *B*, 8, No. 3, 1933; 9, No. 4, 1934). Many lakes and ponds have been investigated in various localities. Only eighteen species of *Cladocera* have been found in the waters round Hokkaidô, *Daphnia longispina* and *Bosmina coregoni* showing the widest range of distribution. The second paper deals with *Daphnia pulex* and *D. longispina*; the latter in a small oligotrophic pond in Kyoto was observed for two years, with the result that two maxima occurred in each year, a conspicuous one in April, and a weak one in autumn. Such a type of seasonal succession in the genus has never been observed in European waters. The rate of growth is greatest in early spring, falling towards summer, and again increasing markedly in autumn. Accordingly the animals are small in size during the summer months, though there was seen no distinct seasonal change in shape from spring to winter. The population was dicyclic in the first year and monocyclic in the second year. The production of males or ephippial females were conspicuously scarce, and the number of parthenogenetic eggs markedly decreases before the commencement of sexual periods, the males always occurring shortly after an extreme maximum of the population. In the third paper it is shown that the local variation of this species is greater than in the other species, its external appearance differing much from lake to lake.

Abdominal Mechanisms of a Grasshopper

UNDER the foregoing title, Mr. R. E. Snodgrass, of the U.S. Bureau of Entomology, has written a memoir which forms a natural sequence to his earlier study entitled "The Thoracic Mechanism of a Grasshopper". The present contribution forms No. 6, vol. 94 of the Smithsonian Miscellaneous Collections (Sept., 1935). The primary object of the work has been to arrive at an understanding of the mechanisms of copulation and oviposition in the family Acridiidæ,

which presents various peculiar features. It is, in fact, a study in functional morphology, and consequently very full consideration is given to the musculature of the abdomen and its associated organs. Following this, the ovipositor and its related parts are treated in detail and likewise the male genitalia. The general title of the paper is, perhaps, too restricted in its implication since it comprises a survey of abdominal organs in the main groups of the Acridiidæ. Like all Mr. Snodgrass's contributions, the work is the result of its author's first-hand study, and is illustrated by numerous excellent text-figures. Space does not admit of any discussion of the author's conclusions and theories; it will serve here to direct the attention of morphologists to a contribution of major importance.

Bombay Grasses

SINCE the publication of the "Flora of Bombay" (1903), many additions have been made to the grass flora of the Presidency, and there have been many changes in generic concepts. In a recent volume (Imp. Council Agric. Research; Scientific Monograph No. 5, 1935) Blatter and McCann have brought up to date the systematic account of the Gramineæ of this area. More than three hundred species belonging to 110 genera are described, and many are illustrated. In the definition and sequence of the tribes, the authors have followed Stapf. Full descriptions of the species are supplemented by vernacular names, notes on etymology, ecology, economic uses and distribution. Keys are given for the genera and species.

The Ranges of Eastern Siberia

MUCH new light on the Yablonovi and Stanovoi and associated ranges of eastern Siberia has been shed in recent years by the work of Russian travellers. This is expounded by Prof. V. A. Obruchev in an article in the *Geographical Journal* of November. Most older maps showed these ranges as marking a continuous divide between the Arctic and Pacific drainage from Mongolia to Bering Strait. Kropotkin, however, separated the two and made the Stanovoi a continuation of the Great Khingan Range. It would now appear that the Yablonovi, which is in the main a faulted horst of crystalline and metamorphic rocks, consists of more than one range, and only in its middle part takes the form of a step between the higher plateau to the west and the lower to the east. On the south it begins about the Chikoi River and on the north it seems to end about the Olekma River. The Stanovoi, on the other hand, is a much longer range beginning at Lake Baikal in the south but not forming a main drainage divide between Arctic and Pacific north of about lat. 60° N. It then curves inland to the north and north-west and cuts off the distinctive north-west and south-east ranges of the extreme east of Siberia. In structure, the Stanovoi is complicated, but the present relief is due mainly to faulting in metamorphic and other ancient rocks, and the formation of a series of horsts and troughs, the former dissected into numerous peaks.

Tokyo Earthquakes in 1934

IN four *Seismometrical Reports* issued by the Earthquake Research Institute, lists are given of the earthquakes felt in Tokyo during the year 1934. Within about eighty miles of the capital, there is a network of fourteen stations, the records at which enable the position of a focus to be determined. During the year, 64 earthquakes were sensible in Tokyo, a number slightly above the annual average, none of them of destructive intensity and one only (in the Idu peninsula) strong enough to throw down vases, etc. Most of the epicentres lie on land to the north of Tokyo Bay, but 2 are under Sagami Bay and 14 beneath the Pacific Ocean and within 45 miles from the coast. In 56 of the earthquakes, the depth of the focus is estimated, ranging from 2½ to 50 miles, with an average of 30 miles.

Turbulence of the Lower Atmosphere

Geophysical Memoir No. 65 of the Meteorological Office is an account of valuable experiments made in 1931–33 on various aspects of turbulence in the layer of atmosphere nearest to the ground, by A. C. Best, under the title "Transfer of Heat and Momentum in the Lowest Layers of the Atmosphere". The experiments were carried out on a ridge of high ground on the south-eastern edge of Salisbury Plain. The instrumental equipment included apparatus for determining the difference of temperature over various height intervals, the lowest layer extending from 2·5 cm. to 30 cm. and the highest from 7·1 metres to 17·1 metres. Thermo-electric couples were used for the lower intervals; these were housed inside concentric tubular nickel-plated brass radiation shields provided with aspiration pipes leading to an electric fan. For the study of the vertical gradient of wind velocity near the ground, air meters of the conventional vane type were used, also special low-speed meters calibrated for velocities as low as 0·3 metres per sec., and a hot wire anemometer that was specially designed for this investigation in order that wind measurements could be made 2·5 cm. above the ground. To those unfamiliar with conditions very near to the ground in clear weather, some of the figures are likely to prove startling, as for example, those giving the absolute extremes of temperature difference between heights of 2·5 cm. and 30 cm., which include a lapse of 10·8° F. on a sunny morning in May and an inversion of 11° F. between the same heights during a night of clear sky in March. The former figure is about 2,000 times the dry adiabatic gradient, a rather larger ratio than has been deduced by D. Brunt as the maximum possible for stable conditions, but Brunt's formula was well supported by the rather lower extremes obtained for hourly means of temperature difference.

Combined Alternating Stresses

A PAPER entitled "The Strength of Metals under Combined Alternating Stresses" was read to the Institution of Mechanical Engineers by Dr. H. J. Gough and Mr. H. V. Pollard, of the Engineering Department, National Physical Laboratory, on November 1. It describes a research, by means of a specially designed high-speed testing machine, into the resistance of metals under combined alternating plane flexural and torsional stresses. A comprehensive study was made of three materials—a normalised 0·1 per cent carbon steel, a heat-treated 3·5 per cent nickel-chromium steel and a silicon cast iron—which were subjected to plane bending stress, torsional stress and five combinations of these. The results showed a simple relation

$$f^2/f_1^2 + q^2/q_1^2 = 1$$

to exist, where f and q represent the bending and

torsional stresses at the fatigue limit due to the applied load, while f_1 and q_1 denote the fatigue limits of stress under simple bending and torsion respectively. It is proposed to apply similar tests to a wide range of steels but, meantime, the authors are of the opinion that "until data for other metals become available it appears unlikely that any serious error would be involved in estimating the fatigue resistance of ductile metals to combined stresses by the use of this equation and the experimentally determined values of f_1 and q_1". The specimens of ductile steel yielded no data regarding the plane on which failure first occurs, whereas the cast iron specimens exhibited close agreement between the fracture plane and that of greatest principal stress.

X-Ray Study of Substituted Edingtonites

IN a paper read before the Mineralogical Society on November 14, W. H. Taylor described an X-ray examination of substituted edingtonites. X-ray investigations of base-exchange products of analcime and natrolite have shown that a monovalent ion like silver takes up the exact position previously occupied by the sodium ion which it replaces. Each divalent barium ion of edingtonite $Ba_2Al_4Si_6O_{20}.8H_2O$ is replaced, however, by two monovalent ions. X-ray work on the thallium compound $Tl_4Al_4Si_6O_{20}.8H_2O$ shows that there is no essential change in the framework of (SiO_4) and (AlO_4) tetrahedron-chains lying parallel to the *c*-axis. The four thallium ions are, however, distributed uniformly among six possible positions made up of a two-fold group and a four-fold group. Of the six possible positions, two are near the positions occupied by barium ions in the mineral edingtonite, the remaining four (one half occupied) are as far distant as possible from other positive ions—thallium, silicon and aluminium. A study of potassium edingtonite yields an almost identical distribution for the potassium ions; small differences in distribution are probably due to incomplete replacement of the barium ions. The observed arrangement of cations satisfies the condition of a uniform distribution of residual valency.

Concentration Cell in Quantitative Analysis

A RAPID and accurate electrometric technique for the determination of small amounts of substances which may occur in salts has been worked out by N. H. Furman and G. W. Low (*J. Amer. Chem. Soc.*, **57**, 1585; 1935) and applied to the determination of small amounts of chloride. It depends on the use of a concentration cell with silver – silver chloride electrodes. The cell is very simple in construction and the results are comparable in accuracy with those obtained by the nephelometer, with the advantage that foreign salts do not cause difficulties as they do in the use of the nephelometer. Traces of chloride so low as 0·00035 gm. per litre were accurately measured. In a second paper the authors compare five different methods for chloride determination, three electrometric and two nephelometric. A new photronic nephelometer is described. The general result is that the electrometric methods are more accurate, easier to perform and less time-consuming. The general experience with nephelometers, that the chief difficulty lies in the reproducibility of the suspensions, was confirmed.

Determination of Iodine in Biological Substances

IODINE plays an important part in the metabolism of the body, since it is present in the molecule of thyroxine, the hormone of the thyroid gland; the normal level of metabolism in warm-blooded animals is only maintained when this gland secretes into the blood-stream for distribution throughout the body adequate amounts of thyroxine. The removal of the iodine atoms from thyroxine leaves a compound which has none of the specific activity of the former substance. Iodine is therefore an important constituent of the diet, but the amounts found in natural sources are exceedingly small and difficult to estimate. The need of a reliable method of estimation is shown by the facts that the incidence of goitre in different regions is related to the iodine content of foodstuffs and the water supply, and that in the converse condition of hyperthyroidism, the blood content of iodine is much greater than normal. C. O. Harvey has recently published the results of an investigation, carried out under the auspices of the Medical Research Council, into methods of estimating minute amounts of iodine, together with a description of a standardised reliable method, based on Hurtley's modification of Von Fellenberg's procedure (Special Report Series, No. 201. London: H.M. Stationery Office, 1935. 1*s*. 0*d*. net). Briefly, the method consists in the digestion of the material with caustic potash, followed by ignition in a nickel dish and extraction of the alkaline mass from the carbon with water. The iodide is extracted with alcohol, oxidised to iodate with bromine water, and the iodine, liberated by addition of potassium iodide, titrated in the usual manner with sodium thiosulphate. Nitrite is destroyed by addition of sodium azide before the oxidation with bromine. Harvey gives full details for carrying out the process, including the methods of preparing the reagents. By his method the iodine in 50 ml. milk, 5 gm. dried vegetable material or 10 ml. blood can be determined, the amounts present being of the order of 1 gamma. With strict attention to all the details of the process, the method has given comparable results in the hands of different workers.

Intensities of Fraunhofer Lines

IN the *Memoirs of the Commonwealth Solar Observatory*, No. 5, Parts 1 and 2, Dr. C. W. Allen discusses the measurement of the intensities of Fraunhofer lines in the spectral region 4036 A.–6600 A. This is the most extensive series of observations which has as yet appeared. The author has used the standard methods of photographic photometry, and his results agree largely with those of other observers who have worked on more limited regions of the spectrum; but the general standard of agreement between one observer and another using this method is not very high. Two observations of the same line, made at different observatories, differing by five per cent between themselves, would count as substantial agreement under present conditions. Dr. Allen confirms the well-known result that solar multiplet intensities can only be reconciled with laboratory and theoretical intensities if a damping constant ten times that given by Lorentz on the classical electromagnetic theory is used in computing the correction for Doppler effect. He is able to show a connexion between the sharpness of the line and the excitation potential of the lower state, and to deduce values for the abundance of the elements in the sun which are in substantial agreement with Russell's values.

Anniversary Meeting of the Royal Society

ON St. Andrew's Day, November 30, the customary anniversary meeting of the Royal Society was held, and Sir Frederick Gowland Hopkins delivered his presidential address. In the course of the address, he referred to the work of the fourteen fellows and four foreign members of the Society who have died since the last anniversary meeting. Speaking of the Report of Council, he stated that a gift of £10,000 has been recently received at the instance of Prof. P. E. Newberry and Mrs. Newberry from the trustees of the late William Johnston, of Liverpool, for the foundation of a fellowship or studentship for research on problems of health. He also said that, in the last ten years, both the *Philosophical Transactions* and *Proceedings* of the Society have doubled in bulk, while the Society's present expenditure on research is nearly ten times that of twenty-five years ago.

At the conclusion of his presidential address, parts of which are printed in this issue (p. 893), Sir Frederick presented the medals for 1935; extracts from his remarks in making the presentations are given below.

PRESENTATION OF MEDALS

Copley Medal, awarded to Prof. C. T. R. Wilson

Prof. Charles Thomson Rees Wilson is awarded the Copley Medal for his contributions to the progress of modern physics by his work on the use of clouds in advancing our knowledge of atoms and their properties. How wide the field of his work has been can be seen from the following summary of his researches. He studied the phenomena of condensation of vapour to form drops by the use of expansion apparatus—which he designed. He discovered the existence of 'rainlike' and 'cloudlike' condensation of water vapour, and measured the corresponding supersaturations and critical expansions. He also measured the supersaturations requisite to produce condensation of water vapour on ions of both signs produced in various ways. He devised and constructed various types of electrometers, and with them and with his cloud apparatus demonstrated the so-called natural ionisation of air and other gases. With a new form of expansion apparatus, he photographed the tracks of ionising particles and radiations traversing gases.

Prof. Wilson next developed methods of measurement which he applied to the study of thunderstorm electricity. In this work the main phenomena relating to the electric field changes produced by lightning discharges were observed for the first time, studied quantitatively, and the principles of their interpretation outlined.

Prof. Wilson further extended the use of the cloud-chamber method. Stereoscopic methods of photographing ionisation tracks in the cloud chamber were applied successfully to the investigation of the properties of photo-electrons and Compton recoil electrons, including their ranges. In recent years, he has continued to make numerous and important contributions to the study of atmospheric electricity and, by introducing important improvements and modifications into his cloud-chambers, he has greatly extended their use.

A Royal Medal, awarded to Prof. C. G. Darwin

A Royal Medal is awarded to Prof. Charles Galton Darwin for his researches in mathematical physics, especially in quantum-mechanics, optics and statistical mechanics. His papers on the reflection of X-rays are now regarded as the fundamental researches on the subject.

In a series of papers on statistical mechanics, written in collaboration with R. H. Fowler, he published a new mathematical technique by which the relation of thermodynamics to statistics was placed on a satisfactory basis, and the way was opened for extensive subsequent developments.

Perhaps the most original and influential of Darwin's papers have been those concerned with quantum-mechanics. The quantum theory of the motion of an electron in an electromagnetic field, as it had been developed before 1925, gave results not in accordance with experiment. To obviate this, in 1925, the assumption was introduced that the electron has a mechanical angular momentum and a magnetic moment; but this conception did not admit of the application of wave-theory, since the waves corresponding directly to such an electron would be in space of six dimensions. It was Darwin who in February 1927 put forward the idea which led ultimately to the solution of these difficulties; he assumed that, just as there are two independent polarised components in a wave of light, so there are two independent components in the wave of an electron. He then constructed a pair of equations to represent the fine structure of the hydrogen spectrum, obtaining all the levels correctly except the *s*-levels, and showed how the equations could be expressed in vectorial form, so that, as he expressed it, the electron was a vector wave.

Among the quantum papers is also numbered the celebrated memoir on "Free Motion in Wave Mechanics", in which he took up the general question of aperiodic phenomena and dealt with it in masterly fashion, the principles of description and interpretation which are now universally accepted being formulated and applied to the free motion of electrons and atoms in various types of field.

A Royal Medal, awarded to Dr. A. Harker

A Royal Medal is awarded to Dr. Alfred Harker as the greatest British petrologist since that subject became a science. In 1886 he published a paper on slaty cleavage, which added considerably to the better understanding of the nature and laws of cleavage phenomena. His next important contribution was the Sedgwick Prize Essay of 1889 on the Bala Volcanic Series of Carnarvonshire. In collaboration with his colleague, J. E. Marr, he published a notable work on the Shap granite and associated rocks.

It is probably true to say that Harker's greatest achievement is the geological mapping of the island of Skye in 1895–1901, the results of which were published as a memoir of the Geological Survey in 1904. This monumental work has had a very wide influence upon the science of petrology: in this memoir and in the subsequent memoir on the Smaller

Islands of the Inner Hebrides, Harker set a high standard of work both in the field and in the laboratory. His book on the "Natural History of Igneous Rocks", published in 1909, has been described as "a work which has had a greater effect than any geological publication in the last fifty years". He has also made contributions of great value to the subject of differentiation of rock magmas, etc. His latest book on "Metamorphism", published in 1932, is the best contribution to the subject written in any language.

Davy Medal, awarded to Prof. A. Harden

Prof. Arthur Harden is awarded the Davy Medal in recognition of his distinguished work in biochemistry and especially of his fundamental discoveries in the chemistry of alcoholic fermentation. In 1904, in collaboration with his colleague W. J. Young, he showed that the alcoholic ferment of active cell-free yeast juice, the preparation of which had been achieved a few years earlier by E. and H. Buchner, could be separated into two components, a thermolabile non-dialysable enzyme complex and a thermostable dialysable co-enzyme, both of these being essential for the fermentation of sugar. They observed that the fermentation of sugars by this yeast juice was profoundly affected by an addition of inorganic phosphate, and followed up this discovery by a detailed and systematic investigation of the carbon balance, from which they showed that, for each hexose molecule broken down to carbon dioxide and alcohol, another molecule became esterified with phosphoric acid. From the fermentation products, hexosediphosphoric and hexosemonophosphoric esters were afterwards isolated by Harden and his colleagues. These discoveries have been the foundation upon which much of our present knowledge of the intermediate changes in the enzymic breakdown of carbohydrate has been established.

Harden has made important contributions to our knowledge of chemical reactions effected by bacterial enzymes, especially those concerned in carbohydrate metabolism. He has also taken an active part in the development of vitamin research in Great Britain, while as editor of the *Biochemical Journal* since 1911 he has influenced deeply the development of this branch of chemistry.

Hughes Medal, awarded to Dr. C. J. Davisson

A Hughes Medal is awarded to Dr. Clinton Joseph Davisson for his discovery that electrons are diffracted like waves of light. Like many other discoveries, this one disclosed itself gradually; but its origin can certainly be traced to some experiments on the scattering of electrons by nickel made by Davisson and Kunsmann in 1921. Davisson recognised at the time that the observed effects did not harmonise with the existing theories of matter and electrons. Owing to the polycrystalline nature of the metals investigated, the correct interpretation to be put upon the results was not at all clear. Davisson fully recognised the importance of this discrepancy, and this he and his assistants proceeded to investigate with great pertinacity and skill.

Towards the end of 1926, Davisson and Germer succeeded in making similar experiments with a single metallic crystal surface, so that the results were simple enough to be interpreted easily. It was then at once seen that the electrons were diffracted like waves of light of the wave-length required by the theory which had in the meanwhile been put forward by M. de Broglie towards the end of 1924. The first announcement of Davisson and Germer's results was published in NATURE of April 16, 1927. This publication was the first clear experimental proof of the wave character of the electron.

Davisson has also made important contributions to thermionics.

Thixotropic Colloids

A PUBLIC lecture on some recent developments of colloid science was delivered at Queen Mary College, London, on November 29 by Prof. H. Freundlich.

Prof. Freundlich pointed out that, whilst it has long been known that a solid gel, such as a gelatin gel, may be liquefied to a sol on heating, and that it returns reversibly to the state of a gel on cooling, investigators in colloid science scarcely realised until recently that an isothermal, reversible, sol-gel transformation is also very frequent. Many gels may be liquefied by shaking or stirring and set to a gel again, in a definite time, when left to themselves. This phenomenon is called thixotropy. It is found not only in true sols and gels (of oxides like Al_2O_3, Fe_2O_3, of gelatin, etc.), but also in concentrated suspensions of coarser particles (of clays, bentonite, etc.). In many cases, thixotropy may be regarded as a first, reversible stage of coagulation, causing the whole sol to unite to one large flake, so to say, which is able to enclose all the liquid present.

Under suitable conditions, some thixotropic sols may be solidified much more rapidly by a gentle, regular movement, a phenomenon called rheopexy. Thus there is a distinct difference between the liquefying action of strong and irregular movement and the solidifying influence of regular, weak vibrations and similar kinds of movement.

Thixotropy generally, perhaps always, involves a loose packing of the particles. The plastic behaviour of such masses also depends upon their loose packing. Hence thixotropy and plasticity are in opposition to Osborne Reynolds's dilatancy, which involves close packing; moist, pure quartz sand shows dilatancy, becoming hard and dry when displaced by an external force, and returning to its original, moist state when this force ceases to act. Foreign substances, such as clay, etc., when added to the sand, form water-binding layers round the particles, thus causing loose packing and thixotropy. A case of quicksand was found the thixotropic behaviour of which was caused by the presence of a fine, clay-like substance; this may be a fairly frequent occurrence. Moulding sands are also plastic and thixotropic because they contain clay and iron compounds.

In many other technical processes (plastics, paints, drilling fluids in the petroleum industry, etc.) thixotropy turns out to be an important factor. Protoplasm is frequently thixotropic, or may readily become so in the course of biological processes.

Educational Topics and Events

CAMBRIDGE.—Trinity College announces the usual offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October 1936 as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year. The studentship is open this year only to men who have not reached the age of twenty-six years before May 1, 1936. Applicants shall ordinarily be nominated by the authorities of their universities. Applications must reach the Senior Tutor not later than May 1, 1936. The same College offers, as usual, Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40. Candidates must apply through the principal authority of their University, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by May 1, 1936.

OXFORD.—In Congregation on December 3, it was proposed to make statutory the decree governing the relations between the committee of the Museum of the History of Science and those bodies which use part of the Old Ashmolean building where the Museum is housed. A concordat was recently arrived at in which the Museum obtains the whole building in "1942 or earlier". By making the decree statutory, the proposers hoped to get this vague phrase interpreted as "early as possible". The motion was defeated by 75 votes to 46. The speakers against it were all sympathetic to the objects of the Museum but they pointed out that until the new extension of the Bodleian library is available, the work in the large room required by the Museum could not be conveniently removed elsewhere. It was stated that probably by 1941 the whole of the building could be given to the Museum.

READING.—Following the installation of Sir Austen Chamberlain as Chancellor of the University on December 2, the honorary degree of D.Sc. was conferred on Sir Rowland Biffen, Sir Frederick Gowland Hopkins, Lord Rutherford and Sir J. J. Thomson.

Later in the day, Sir Austen announced that the installation of the new Chancellor is being commemorated by the gift from Mr. Reginald Marden of the freehold of Shipley Court Farm, a fine property of more than 300 acres, representing a value of £10,000–£15,000.

DR. ERNEST RENAUX has been nominated successor to Prof. Jules Bordet in the chair of bacteriology in the University of Brussels.

THE annual Conference of the Geographical Association will be held in the London School of Economics on January 1–3. On January 1, Mr. J. Fairgrieve will deliver his presidential address entitled "Can we Teach Geography Better?" On January 2, a symposium on "Soils in Geography" will be held, when the speakers will be Dr. W. G. Ogg, Dr. S. W. Wooldridge and Dr. L. Dudley Stamp. On the same day, Dr. E. B. Worthington will deliver a lecture on "A Biologist Looks at Africa", and a discussion on "The Use of the Epidiascope in the Teaching of Geography in Schools" will be opened by Mr. L. S. Suggate. On January 3 there will be two discussions, namely, "Higher Certificate Courses in Geography", to be opened by Mr. L. B. Cundall and Mr. H. W. Ogden, and "A Geography Course in Senior Schools", to be opened by Mr. A. E. Moody; and a lecture by Dr. H. J. Wood on aspects of irrigation development in the western United States. On January 4, there will be a demonstration of films for use in the teaching of geography in the Gaumont-British Theatre, Film House, Wardour Street, W.1. This will be followed by a discussion. Further information can be obtained from the Secretary, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

Science News a Century Ago

Faraday and Lord Melbourne

PRIOR to 1835, several men of science had received the honour of knighthood, and during the first administration of Sir Robert Peel, which lasted from December 16, 1834, until April 18, 1835, Civil List pensions were bestowed on Mrs. Somerville and Prof. Airy. Faraday's name had also been put forward in connexion with the award of pensions. After at first refusing to acquiesce in the proposal, Faraday had his memorable interview with Peel's successor, Lord Melbourne, which led Faraday afterwards to write to his Lordship: "The conversation with which your lordship honoured me this afternoon, including as it did your Lordship's opinion of the general character of the pensions given of late to scientific persons, induces me respectfully to decline the favour which I believe your Lordship intends for me. . . ."

An article afterwards appeared in *Fraser's Magazine* entitled "Tory and Whig Patronage to Science and Literature", which purported to give an account of the interview. Comments on the article appeared in the Press, and on November 28, 1835, *The Times* gave a long extract from it. On December 7, Faraday wrote to the editor of *The Times* saying, "neither directly nor indirectly did I communicate to the Editor of *Fraser's Magazine*, the information on which that article was founded, or further, either directly or indirectly, any information to or for any publication whatsoever." The letter was published on December 8.

Airy Declines a Knighthood

IN his autobiography, Airy noted under the year 1835: "On Dec. 8th Mr. Spring Rice and Lord John Russell offered me knighthood, but I declined it." At that time, Lord Melbourne was Prime Minister, Spring Rice Chancellor of the Exchequer, and Lord John Russell Home Secretary. Airy's letter to Spring Rice declining the honour was written from the Observatory, Cambridge, on December 10, just before he left for Greenwich.

In the course of his letter, Airy said: "The unalterable custom of this country has attached a certain degree of light consideration to titles of honour which are not supported by considerable fortune; or at least, it calls for the display of such an establishment as may not be conveniently supported by even a comfortable income. The provision attached to

my official situation, and the liberality of the King towards one of the members of my family, have placed me in a position of great comfort. These circumstances however have bound me to consider myself as the devoted servant of the country, and to debar myself from efforts to increase my fortune which might otherwise have been open to me. I do not look forward therefore to any material increase of income, and that which I enjoy at present is hardly sufficient, in my opinion, to support respectably the honour which you and Lord John Russell have proposed to confer upon me. . . ."

Sir Charles Bell and his Edinburgh Professorship

ON December 8, 1835, when Sir Charles Bell was about to succeed to the chair of surgery at Edinburgh, he wrote from London to his brother George: "I have seen enough to satisfy me of what the world can offer to a man—I mean this great world; and were you to look back to my letters, you would find the opinion, uniformly expressed, that the place of a professor who *fills his place* is the most respectable in life. My hands are better for operation than any I have seen at work, but an operating surgeon's life has no equivalent rewards in this world; I must be the teacher and consulting surgeon to be happy. Do you remember this is the fifth offer I have had to return to lecturing?" The same day his brother wrote from Edinburgh: "You are now an adopted member of this University, and with the unanimous assent and acclamation of a Town Council composed of persons of all parties, chosen by the several wards of this intellectual city. And surely never was an offer more honourable to an individual, for I do assure you it has the approbation of all ranks and classes of men, and of none more than the Professors of the University and the whole medical profession."

Electrostatics: a Cold Night on the Roof

"IT may be a question," wrote Faraday on December 10, 1835, "whether every case of electric residence on the surface of conductors in our atmosphere is not a case of induction"; and proceeded to try experiments to see if a metallic surface could retain any charge if there was no other surface or object opposite to it. A large concave mirror was insulated on the lecture room table, its curved surface facing upwards to the ceiling, and charged electrically. When the distribution of charge was examined, it was found to correspond with that in earlier experiments. The intensity was greatest at the edges; no electricity could be obtained from the lowest central part. The topmost point only of a ball rested at the centre showed a feeble charge.

But these effects might be due to inductive action of the ceiling, thought Faraday, although it was far above the lecture table; and so: "Then removed all this apparatus to the roof of the house, into a situation where a straight line drawn from the upper point of the 3 inch ball in the mirror, and passing by the edges of the mirror, could reach no external object except the starry sky. The sky was clear; the stars bright; the cold great, being about 27° or 28° and freezing fast at the time. Then repeating the experiments as within the house as nearly as possible, the same electrical effects were produced. Hence electricity can exist upon surfaces which are not inductively related to other surfaces of conducting matter".

Societies and Academies

DUBLIN

Royal Irish Academy, November 11. W. B. MORTON: Settlement from a suspension flowing through a tube of circular section. The rate of precipitation is examined on the two limiting assumptions of steady Poiseuille flow and of a distribution of particles maintained in uniformity across the section of the tube by eddies. J. J. NOLAN and V. H. GUERRINI: The diffusion coefficients and velocities of fall in air of atmospheric condensation nuclei. Methods for determining these quantities are described. The values found for nuclei in Dublin air are $D = 18 \times 10^{-6}$ and $V_g = 7 \cdot 5 \times 10^{-5}$. From these values the mass of the nucleus is deduced to be $1 \cdot 68 \times 10^{-16}$ gm. and its radius $2 \cdot 85 \times 10^{-6}$ cm. As the concentration of nuclei in air falls off with time, the nuclei are found to be of larger size. The bearing of this variation in size on the part played by the nuclei in the equilibrium of atmospheric ionisation is pointed out.

PARIS

Academy of Sciences, November 4 (*C.R.*, 201, 801–860). LUCIEN DANIEL: The heredity of monstrosities in the descendants of the Jerusalem artichoke grafted on the annual sunflower to the eighth sexual generation. JEAN LE ROUX: Non-Euclidian distances. NICOLAS LUSIN: The choice of a perfect ensemble distinguished in an arbitrary analytical complement having non-enumerable constituents. G. DEINFELD: Integral invariants. N. ARONSZAJN: The metric characterisation of Hilbert space, of vectorial spaces and of certain metric groups. ANTOINE APPERT: New remark on the maximum of semi-continuous functionals. MAX SERRUYS: A rational scale of classification of fuel for internal combustion engines. The fuel is used in a motor under closely defined conditions of working, and compared with a fuel composed of a definite mixture of heptane and *iso*-octane. MARCEL CHÂTELET and FRANÇOIS KERTÉSZ: The activity of the chlorine ions in some solutions of complex chlorides of cobalt and chromium. ALBERT PORTEVIN and MICHEL CYMBOLISTE: Study of electrolytic baths. JEAN SWYNGEDAUW: The phenomena of electro-filtration in the electrolysis of gels. LÉON BLOCH, EUGÈNE BLOCH and CHOONG SHIN-PIAW: The emission spectrum of the selenium oxide, SeO. The fundamental vibration frequencies of the molecule SeO in the normal and excited state are $908 \cdot 9$ cm.$^{-1}$ and $533 \cdot 4$ cm.$^{-1}$. The energy of dissociation of the molecule in the normal state was found to be $5 \cdot 31$ volts. FRÉDÉRIC JOLIOT, ANDRÉ LAZARD and PIERRE SAVEL: The synthesis of radio-elements by deuterons accelerated by means of an impulse generator. ALBERT MICHEL-LÉVY and ANDRÉ MURAOUR: The variation of detonation spectra with the nature of the surrounding gas. A mixture of tetranitromethane and toluene was detonated in different gases, argon, krypton, carbon dioxide, nitrogen, air, helium, hydrogen and chlorine. Reproductions of the spectrographs obtained are given. The results support the hypothesis attributing the observed luminosities to the stimulation by the shock waves of the gas molecules surrounding the explosive. WILFRIED HELLER: The distances between the colloidal particles in the bright layers of certain iron oxide sols. The author has found a method of preparing artificially the bright layers discovered by

Zocher: the method is based on the slow hydrolysis of solutions of ferric chloride. An outline of the theory of the phenomena is given. JEAN SAVARD: The Raman spectra of methyldiethylcarbinol, dimethylbenzylcarbinol and the corresponding ethylene hydrocarbons. Frequencies due to the phenyl group, and the C.H and C=C linkages are given: tentative frequencies for other groups are suggested, but require confirmation by further work. All compounds containing the ethyl group give an intense line of frequency about 720. ARAKEL TCHAKIRIAN and MICHEL LEWINSOHN: Preparations of alkyl trihalogenides or of phenyl germanium of the type $RGeX_3$ and of methylene germanium hexachloride. ANDRÉ CORNILLOT and RENÉ ALQUIER: The reaction of acetylene with acetyl chloride. In the presence of aluminium chloride, acetylene and acetyl chloride give methyl-β-chlorvinylketone, $CH_3.CO.CH=CHCl$. This is very unstable: treated with boiling alcoholic soda, besides much tarry matter, this compound gives 20–25 per cent of triacetylbenzene. JACQUES BOURCART: The Quaternary of the coast of Rabat (Morocco). S. DEB: The discovery of an Orbitoid in the Annot (Alpes-Maritimes) grits. JACQUES FROMAGET: New observations on the upper Trias of western Tonkin and on the Norian age of the *Myophora napengensis* layers. FERNAND OBATON: A method for the rapid determination of the quantity of water contained in the soil. The method is based on the determination of the electrical resistance of a column of soil under a fixed pressure. The conversion of electrical resistance into moisture content is based on a curve reproduced. RENÉ SALGUES: The erythrocytes, hæmoglobin and the globulin value in the bird. JACQUES PELLEGRIN: The buccal variations in the barbel of the Kivu region. ROBERT WEILL: The working of the colloblasts. MAURICE CAULLERY: Remarks on the preceding communication. J. TIMON-DAVID and G. CERESOLA: The influence of sex on the lipids of some marine molluscs. JEAN COURTOIS: The action of various chemical compounds on the plant phosphatases. MME. PAULETTE CHAIX: The action of some compounds containing sulphur on the fermentation of glucose by propionic bacteria (*Propionibacterium*). WACLAW MOYCHO: Do bacteria secrete protease? Oppenheimer and Enler hold that living bacteria have not the power of secreting proteolytic enzymes, the latter only being liberated after the death of the cell. This view has not been proved experimentally, and has been adversely criticised. The author describes experiments with *B. prodigiosum* which he regards as clearly proving that the enzymes are only liberated after the death of the bacterium.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 561–585, Oct. 15). C. P. HASKINS: A determination of the magnitude of the cell 'sensitive volume' associated with the white-eye mutation in X-rayed *Drosophila*. The results of exposure for different periods to the same source of X-rays suggest that passage of a single electron through this locus is sufficient to cause a mutation. Assuming that every electron causes a mutation, the minimum volume of the white loci in the X-chromosomes of all cells of the optic *anlage* at the time of treatment is $37 \cdot 06 \times 10^{-18}$ c.c. TH. DOBZHANSKY and A. H. STURTEVANT: Further data on maternal effects in *Drosophila pseudo-obscura* hybrids. CHESTER STOCK and FRANCIS D. BODE: Occurrence of Lower Oligocene mammal-bearing beds near Death Valley, California. This is the first time these fossils have been recorded in the Great Basin Province, which is far from previously known areas of occurrence. A definite age determination has been made for the lowermost formational unit in the Tertiary rock sequence of the Grapevine and Funeral Mountains forming the north-east wall of Death Valley. Geological sections are given. ARTHUR E. KENNELLY: Adoption of the metre-kilogram-mass-second (M.K.S.) absolute system of practical units by the International Electrotechnical Commission (I.E.C.), Brussels, June 1935. An account of the history of electrical units and a list of sixty-one quantities with their symbols, M.K.S. and C.G.S. units. BERTIL HANSTRÖM: Preliminary report on the probable connexion between the blood gland and the chromatophore activator in decapod crustacea. Extracts from the eyestalks of most of the crustaceans examined cause concentration of pigment within the skin chromatophores. The active regions on microscopic examination are found to contain the blood gland and the X-organ, both of which receive nerves from a part of the brain connected with the optic paths. It is believed that the blood gland is the source of the chromatophore activator, though the X-organ may also be concerned with the colour changes of crustaceans.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, December 8

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".*

Monday, December 9

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—C. Musters: "Some Zoological Collecting Trips".*

SWINEY LECTURES ON GEOLOGY, at 5.30.—(at the Imperial College of Science, Exhibition Road, South Kensington, S.W.7).—Dr. Frederick Walker: "The Formation of British Coast Lines" (succeeding lectures on December 11, 13, 16, 18, 20, January 1, 3, 6, 8, 10 and 13).*

Tuesday, December 10

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. P. Hartley: "International Biological Standards for Drugs and Therapeutic Substances".

Thursday, December 12

ROYAL ASIATIC SOCIETY, at 4.30.—Mme. Gabrielle M. Vassal: "The Temples of Yunnan".

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. Cecil Wall: "The Surgeons' Company, 1745–1800" (Thomas Vicary Lecture).*

Friday, December 13

ROYAL SOCIETY OF ARTS, at 4.30.—Khan Bahadur Sheikh Sir Abdul Qadir: "The Cultural Influences of Islam in India" (Sir George Birdwood Memorial Lecture).

ROYAL INSTITUTION, at 9.—Sir Richard Paget: "Sign Language as a Form of Speech".

Saturday, December 14

ROYAL INSTITUTION, at 3.—Dr. W. Percival Yetts: "Chinese Bronzes".

EXHIBITION OF MICROSCOPES BY W. WATSON AND SONS, LTD., December 9–14.—To be held in the Central Hall, Westminster, S.W.1.*

December 10, at 7.—T. H. Turner: "The Part the Microscope plays in the Scientific Control of the Railway".*

December 11, at 7.—M. Duncan: "The Microscopist at the Seaside".*

December 12, at 7.—H. C. Rands: "The Manufacture of Optical Glass".*

Official Publications Received

Great Britain and Ireland

The Registrar-General's Statistical Review of England and Wales for the Year 1934. (New Annual Series, No. 14.) Tables, Part 1, Medical. Pp. iv+409. (London: H.M. Stationery Office.) 6s. net. [1911

British Empire Cancer Campaign. Twelfth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 25 November 1935. Pp. xxxi+247. (London. British Empire Cancer Campaign.) [2111

Forestry Commission. Report of the National Forest Park Committee, 1935. Pp. 8. (London: H.M. Stationery Office.) 6d net. [2211

London and Cambridge Economic Service. Special Memorandum No. 40: The Effect of Present Trends in Fertility and Mortality upon the Future Population of England and Wales and upon its Age Composition. By Enid Charles. Pp. 20. (London: London and Cambridge Economic Service, c/o London School of Economics.) 5s. [2211

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1934–35 Pp. 40. (Aberdeen: North of Scotland College of Agriculture.) [2511

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 12: The Inheritance of Fuzz and Lintlessness and Associated Characters in Asiatic Cottons. By J. B. Hutchinson. Pp. 20. (London: Empire Cotton Growing Corporation) 2s. 6d. [2511

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1935; with Report of the Director of Fuel Research. Pp. xi+188+11 plates. (London: H.M. Stationery Office.) 3s. 6d. net. [2711

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Twelfth Conference held at St. John's College, Cambridge, September 20th to 23rd, 1935. Pp. 126. (London: Association of Special Libraries and Information Bureaux.) 5s. [2711

Sixth International Congress for Scientific Management, London, July 15th to July 20th, 1935. Proceedings. Pp. 234. (London: P. S. King and Son, Ltd.)

Thirty-third Annual Report, 1934–1935, of the Imperial Cancer Research Fund. Pp. 36. (London: Imperial Cancer Research Fund.) [2811

Amgueddfa Genedlaethol Cymru: National Museum of Wales Twenty-eighth Annual Report, 1934–35, presented by the Council to the Court of Governors on the 25th October 1935. Pp. 42. (Cardiff National Museum of Wales.) [2811

Other Countries

Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Section. Bulletin No. 1: Some Hydrographic Data from the Suez Canal, 1928–29. By R. S. Wimpenny. Pp. 7+5 plates. 10 P.T. Notes and Memoirs, No. 8. The Fishery Grounds near Alexandria. 1: Preliminary Report. By Adolf Steuer. Pp. 18+6 plates. Notes and Memoirs, No. 9: The Fishery Grounds near Alexandria 2 A Bottom Sample taken at Alexandria. By Aristocle Vatova. Pp. 3+1 plate. Notes and Memoirs, No. 10: The Fishery Grounds near Alexandria. 3: Cirripeds. By Hjalmar Broch. Pp. 5+1 plate. Notes and Memoirs, No. 11: The Fishery Grounds near Alexandria. 4: Some Marine Mites from Alexandria. By Dr. Karl Vieta. Pp. 3+2 plates. Notes and Memoirs, No. 12: Die Fischereigrunde vor Alexandrien. 5: Ostracoda. Von Walter Klie. Pp. 9+1 plate. (Cairo: Government Press.) [1911

National Research Council. Transactions of the American Geophysical Union, April 25 and 26, 1935, Washington, D.C. Part 1: Reports and Papers, General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 364. 2 dollars. Part 2: Reports and Papers, Section of Hydrology. Pp. 365–530. 1 50 dollars. (Washington, D.C.: National Academy of Sciences.) [1911

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 7: Investigations on the Course of Growth in a Virgin, or Plant, Crop of Sugar Cane (Variety White Tanna). By Dr. H. Evans. Pp. 36+25 plates. (Port Louis: Government Printer.) [2011

University of Illinois Bulletin. Vol. 32, No. 52: Development of the Pectoral Limb of *Necturus maculosus*. By Hsin Kuo Chen (Illinois Biological Monographs, Vol. 14, No. 1.) Pp. 71. (Urbana, Ill.. University of Illinois Press.) 1 dollar. [2211

Federated Malay States. Report on the Progress of Schemes for the Improvement and Extension of Rice Cultivation. Pp. 12+8 plates. (Kuala Lumpur: Government Printer.) 1 dollar; 2s. 4d. [2511

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1934. By Dr. W. Youngman. Pp. D200. (Colombo: Government Record Office.) 2 rupees. [2511

University of Illinois: Engineering Experiment Station. Bulletin No. 278: Oscillations due to Corona Discharges on Wires subjected to Alternating Potentials. By Prof. J. Tykocinski Tykociner, Raymond E. Tarpley and Prof. Ellery B. Paine. Pp. 56. 60 cents. Bulletin No. 279: The Resistance of Mine Timbers to the Flow of Air, as determined by Models. By Prof. Cloyde M. Smith. Pp. 64. 65 cents. Bulletin No. 280: The Effect of Residual Longitudinal Stresses upon the Load-carrying Capacity of Steel Columns. By Prof. Wilbur M. Wilson and Rex L. Brown. Pp. 28. 30 cents. Circular No. 24: Simplified Computation of Vertical Pressures in Elastic Foundations. By Nathan M. Newmark. Pp. 19. 25 cents. (Urbana, Ill.: University of Illinois.) [2511

Bulletin of the American Museum of Natural History. Vol. 86, Art. 8: Results of the Archbold Expeditions. No. 7: Summary of the 1933–1934 Papuan Expedition. By Richard Archbold and A. L. Rand. Pp. 527–579+plates 28–46. (New York: American Museum of Natural History.) [2511

Sveriges Geologiska Undersokning. Ser. C, No. 390: Blockundersökningar; Historik och methodik. Av G. Lundquist. Zusammenfassung: Geschiebeuntersuchungen; Historik und Methodik. Pp. 45. 1.00 kr. Ser. C, No. 391: Gästrikländska fornstrandlinjer och nivåförändringsproblemen. Av Bror Asklund. Pp. 119+3 plates. 3.00 kr. Ser. C, No. 392: On the Origin of late Magmatic Solutions containing Magnesia, Iron and Silica. By N. Sundius. Pp. 24. 0.50 kr. (Stockholm: P. A. Norstedt and Soner.) [2511

Society of Biological Chemists, India. Influence of Light on some Biochemical Processes. By Dr. N. R. Dhar. Pp. iv+73. (Bangalore: Society of Biological Chemists, Indian Institute of Science.) 1 rupee. [2511

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 151. A New Method of staining Mycobacterium Tuberculosis, a Scientific Microbiological Note. By Prof. Dr. Matteo Carpano. Translated to English by Dr. H. Fadel. Pp. 9+7 plates. (Cairo. Government Press.) 15 mills. [2511

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 21: Reports of the Research, Economic and Agricultural Education Branches for the Year 1934. Pp. iii+90. (Kuala Lumpur: Government Press.) 50 cents. [2511

Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1934. By Dr. H. A. Tempany. Pp. iv+78. (Kuala Lumpur: Government Press.) 50 cents; 1s. 2d. [2511

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Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3450 SATURDAY, DECEMBER 14, 1935 Vol. 136

Nazi-Socialism and International Science

EVENTS of the past few years have accustomed us to the knowledge that the position of 'non-Aryan' scientific colleagues in official positions in the German Reich has become intolerable, even in the few cases where they have not been expelled from office. Now a new situation is developing which may be fraught with considerable danger to the continued co-operation of workers in other countries with their German colleagues. This new development carried to the limit can only result in the isolation of German men of science in all matters of international organisation.

The unwelcome move, to which attention has been directed in a recent issue of the *Basler National Zeitung*, is the use that the Nazi authorities intend to make of international congresses for their own purposes. The Reichsminister of Propaganda has created a 'Science Congress Centre' (Wissenschaftliche Kongres-zentrale), one of the objects of which is to use scientific congresses as opportunities to influence public opinion through the medium of the important persons attending. No longer is this to be left to the chance of personal and friendly relations between the foreigners and the Germans present, but, where possible, steps are to be taken to introduce ideas of a Nazi-socialistic stamp into the discussions of matters of world moment.

For meetings held in Germany, the new centre would act as an intermediary between the Government and party officials on one hand, and the president and officers of the congress on the other. The programmes of the meeting and the lists of speakers would be subject to the approval of the centre: thus international conferences held in Germany are to be sifted of undesirable elements by the authorities beforehand and to survive as meetings approved by the Nazi party. For meetings held outside Germany the control must necessarily be much less, but here too it is possible to influence matters by sending German members to a meeting as a delegation under an appointed leader chosen for his reliability as a member of the Nazi party.

The meeting of the Astronomische Gesellschaft held at Berne last summer may be cited as an example of the working of the new machine. The Astronomische Gesellschaft is a long-established body with headquarters in Germany but with strong international affiliations, which have been particularly stressed by the Germans in recent years. One of the valued secretaries of the Astronomische Gesellschaft came up for re-election at the meeting and in the ordinary course of events would have been re-elected without question: on purely scientific grounds there was every reason for his continuance in office. This was, however, against the views of the German delegation, whose members were instructed not to vote for a Jew: alternative names were put forward and it became clear in the course of the meeting that something more vital was at stake than the question as to the holder of a particular office; in fact, nothing less was at issue than the question whether an organisation of international standing and repute should come under the control of an anti-Semitic clique. When the vote was ultimately taken by secret ballot, it was found that the Nazi element had failed in its attempt, and the threatened secession of non-Germans from the Astronomische Gesellschaft was averted for the time. But the danger of subsequent development remains a source

of anxiety to those concerned in international scientific relations.

It should be added in fairness to the Germans that internal persecution of a minority is not limited to their country, nor even the use of international gatherings to spread nationalist political propaganda. Both these undesirable practices are to be found in more than one country: we have no sympathy for either. But when these tendencies spread and a nationalistic movement tries to secure the control of international scientific work, it is time to call a halt.

Health and Safety in Industry*

THE report of the Chief Inspector of Factories and Workshops for 1934 gives some interesting illustrations of the part which science has still to play in the prevention of industrial accidents and the safeguarding of industrial health. Scientific investigation is, of course, a main factor in the continuous improvement of processes so that operating conditions more and more eliminate dangers to health from noxious fumes or poisonous substances.

It is not, however, the field for further investigation which is here presented or the lack of exact knowledge of the effects of many well-known substances, particularly their cumulative effect, that is most impressive in the present report. Welcome as may be the evidence of the painstaking effort in this field to track down causes and to foresee possible dangers, a good deal remains to be done to secure effective co-operation and co-ordination between different branches of science, as well as between employer and employee.

The further we advance in this field of industrial health, the more important voluntary effort and the less effective legal compulsion become to secure the ends in view. Scientific research must supply the exact knowledge upon which effective action is based. Then comes the problem of securing that effective action is taken, and in this matter the co-operation of the employer and employee is essential. Once more, however, the report provides evidence that only continuous and expert supervision can ensure that co-operation is unbroken either by ignorance, indifference or neglect, whether studied or involuntary.

What is required is not merely the supervision exercised by inspectors of factories, but also the close and continuous oversight which can only be exercised by a scientific personnel in industry. Where in this way expert knowledge and a trained mind can be brought to bear on the design of plant or development of processes from the point of view of the health and safety of those operating them, and still more on any unforeseen emergency which may arise, the risk of untoward injury to health is largely reduced. Where scientific personnel is absent or too heavily charged with other duties to exercise such oversight, the risks are correspondingly greater; the report refers, for example, to a factory in which all the processes entailing the most serious risks, were carried out by a proprietor who had a scientific training and the necessary knowledge and skill to avoid serious injury. So long as this process (the manufacture of hydrogen cyanide) can be kept in the hands of persons with the requisite knowledge it appears that the danger of the process can be controlled; but as a result of increased demand for the acid, the manufacture may possibly fall into the hands of inexperienced persons, with consequent risk.

This reference alone demonstrates sufficiently that it is not only in the manufacture of pharmaceutical preparations intended for the internal treatment of human ailments that properly qualified supervision is required in the public interest. There are many other processes and operations which equally demand the personal control of a properly qualified chemist, engineer, physicist or other scientific worker or technician, and this is a matter which demands the continuous attention of the professional organisations of chemists and others.

Equally impressive, however, is the picture the report supplies of the need for co-operation, and particularly on the medical side. Much of the value of medical supervision is lost because of the lack of knowledge of many general practitioners of the work of the medical inspectorate of factories, of factory legislation and of diseases of industry. The psychological effects of ill-founded sickness certificates "due to employment" are far-reaching

* Annual Report of the Chief Inspector of Factories and Workshops for the Year 1934. (London: H. M. Stationery Office, 1935.) (Cmd 4931.) 2s.

and as serious to the individual as they are embarrassing to industry and to the scientific investigation of the incidence and causes of industrial disease. Any efforts at educational work such as the inclusion of appropriate lectures in the medical curriculum which facilitates co-operation should be of immense ultimate benefit.

Another direction in which co-operation is called for is between different classes of scientific workers. Notably is this true of the work of the medical officers now to be found in most large works or firms on a part-time or full-time basis. While it is essential that, with the medical man as with the chemist or engineer or other professional worker, his own professional associations and traditions should come first, professional independence should not be allowed to stand in the way of team work. It is only as the medical man takes his place in the industrial team in this field in the same way as the engineer, the chemist, the biologist, physicist or administrator, and knowledge and experience gained from many angles is pooled for the general advantage, that we can hope to secure the maximum elimination of industrial risks.

The possibilities in this field indeed have scarcely been glimpsed, although Dr. L. Teleky has directed attention to the opportunities and need for co-operation in research, and Dr. H. E. Collier in a recent address before the Industrial Welfare Society's Advisory Medical Committee gave an inspiring vision of the place of a university in an industrial hygiene service. Certain of the functions outlined, such as training the personnel of such a service, propagating existing knowledge and establishing or maintaining organic contact with those actually engaged in health work in industry, have scarcely yet been touched.

The training of personnel for industrial health work is closely allied to a matter on which special stress is laid by the Chief Inspector's report. The high incidence of industrial accidents among juvenile workers is not generally realised, and although the accidents themselves are less serious, as indicated by a lower fatality rate, the situation is one which demands every effort to remedy. Certain qualities of youth probably render the young entrant to industry specially susceptible to accidents, and it is as incumbent on us to give him an apprenticeship in safety as in his productive work, and to see that he is adequately forewarned of the dangers inherent in all industrial life. Pre-eminently this is a field in which goodwill and voluntary efforts of employers and of responsible officers are far more valuable than legislation which would be equally difficult to draft and to enforce.

Sir Donald MacAlister

Sir Donald MacAlister of Tarbert
By his Wife. With Chapters by Sir Robert Rait and Sir Norman Walker. Pp. vii+392. (London: Macmillan and Co., Ltd., 1935.) 12*s*. 6*d*. net.

WHEN in January 1934 Sir Donald MacAlister died at Cambridge, there passed from among us one of the most influential men of our time. He had been for forty-four years a member of the General Medical Council, and for twenty-seven its president. He had also been principal and Vice-Chancellor of the University of Glasgow for twenty-two years, and its Chancellor for the last five years of his life. It is a remarkable record, particularly when we remember the numerous and varied official and unofficial public duties fulfilled within the same period of life. Both these official posts were concerned with what is called administration, but in MacAlister's career, the administrative faculty was combined with exceptional, not to say extraordinary, capacities in other directions. Here was a man who began as Senior Wrangler at Cambridge in 1877, and was teacher and tutor in his College, linguist, poet, mathematician, physician, physiologist, pharmacologist, biologist, and even moralist. He could apparently have excelled alike in the medical, administrative, judicial or ecclesiastical spheres—an 'Admirable Crichton', or a model for Angus Sutherland in William Black's yachting novel, "White Wings".

The story which Lady MacAlister tells is full of interest, happiness and inspiration, and most of the many readers who will turn to it, old students of Cambridge and Glasgow and medical men the world over, are likely to find its 390 pages all too short for their desire. Donald MacAlister deserved indeed to become the titular head of

British medicine, for added to his natural gifts he lived a life of immense diligence and devotion to the task in hand. Public service was his native breath, and strenuous toil his daily lot. He was born in Perth in 1853, the son of a publisher's agent and manager, of good Presbyterian stock; he was at school first in Aberdeen and, when ten years of age, in Liverpool, whither his parents had removed. It was at the Liverpool Institute that Sir Henry Roscoe learned the elements of chemistry as MacAlister those of mathematics, but the latter obtained more material reward in the nature of prizes and scholarships, which took him to St. John's College, Cambridge. After winning the senior wranglership he taught mathematics at Harrow, then under Dr. Montagu Butler, afterwards returning to Cambridge and St. Bartholomew's Hospital to study medicine. He took his M.B. in 1881 and his M.D. in 1884, supporting himself, both as student and after qualification, by literary work for the *Journal of Education*, *The Times*, and the *Pall Mall Gazette* in the days of Mr. John Morley. After a few months physiological work under Karl Ludwig at Leipzig, and having been awarded a fellowship of St. John's, he settled down at Cambridge, filling a number of medical posts, including a lectureship and tutorship at St. John's, a medical appointment at Addenbrooke's hospital, and private medical practice. He married a 'Highland cousin' in 1895.

It was during his early days at Cambridge that MacAlister became interested, with several of his fellow students, in the education of adults, becoming a teacher in the Nelson Street Adult School. "From an early age the things of the spirit meant much to Donald"—then, and afterwards, he became a student of the Bible in various languages, a practice which widened his interests and qualified him in exceptional degree for his public reading and exposition in after days at Glasgow. This particular interest was doubtless the mainspring of his social interest in Toynbee Hall, university extension work with Prof. James Stuart, the physical training of youth, his work for the Carnegie Foundation, his devotion to the welfare of university students, the Workers' Educational Association, and the School of Social Study. He was both cosmopolitan and catholic in spirit, and always the friend of well-designed schemes of social reform.

In 1907, MacAlister's intention of writing the biography of Prof. John Couch Adams, the discoverer of the planet Neptune, and for 'going round the world' were frustrated by his appointment, by the Prime Minister, as principal of the University of Glasgow. He accepted this high post with some hesitation, "for seven years and no longer". But he stayed there for twenty-two years. Something of what he accomplished is described in the book by his successor, Sir Robert Rait. Though never physically strong, since an attack of rheumatic fever in childhood, and often suffering pain, he carried through the immense and ever-extending burden of routine administrative work involved in such an onerous appointment. Particularly, of course, his advent strengthened the faculty of medicine, extending the hospital teaching provision, enlarging the professoriate, providing for women medical students, reorganising the curriculum of study, introducing new research facilities and making larger arrangements for the social life and well-being of the students. Not the least of his labours was that of piloting a great and growing university through the years of the Great War. Yet in the ten years after the War, so solid was the reconstruction that no fewer than fifteen new professorships were founded in the University.

It is perilous to compare the values of the achievements of a man's life. Sir Donald MacAlister was for a whole generation one of the outstanding figures in the public and educational life of Great Britain. As principal, and finally as Chancellor, after Lord Rosebery, of a large university sending its alumni all over the Empire, his influence was ever widening and deepening; as president of the General Medical Council for twenty-seven years his wise guidance of the medical profession is not less immeasurable. His consummate learning, his versatility, his extraordinary circumspection, his lucidity and understanding, his wisdom and judgment were placed for this long period at the service of the profession he had chosen. It was accompanied, almost invariably, by patience, courtesy and good humour —"never hurried, never annoyed, never out of temper, never bored, never at a loss". What a temperament and what a testimony such words truly represent!

One of MacAlister's duties, first and last, was to clear up and dissipate misconceptions about the Medical Council. "It is scolded for doing what the law says it *shall* do. It is bitterly reproached for leaving undone what the law gives it neither power nor means to do". Its purpose is not to protect doctors but the public. It is a council of *education*; a board of *registration* of the qualified men; a professional court of justice, the only sentence of which is erasure from such register. From 1889, when he was elected to represent the University of Cambridge, until 1933, when he retired from the representation of Glasgow, MacAlister devoted his mind and his energy to the guidance and service of the Medical Council. He began as the wise reformer of the medical curriculum, which is recommended by the Council

to the teaching and examining bodies; he was one of the principal designers and critics of the "Pharmacopœia" issued by the Council; he reorganised the procedure and finance of the Council; he strengthened mutual 'reciprocity' between medical men throughout the Empire; above all, he laboured for a 'clean' register, by regularising the arrangements for ensuring justice. Every complaint against the conduct of doctors must be properly explored, and proved to the satisfaction of their peers on the Council. There must be nothing arbitrary, accusative or capricious, and the doctor must be fully and fairly heard. All this was carried through, year after year, within the requirements of the Medical Acts, under the supervision of the Privy Council, and before the eyes of the public. The honour and dignity and usefulness of the healing art must always be safeguarded. Little wonder that confidence in the Council has steadily increased in the profession, among the public, and by the courts of justice. Much of this achievement was part of MacAlister's life-work.

Lady MacAlister has given us an admirable record, lucid and business-like as MacAlister himself would have wished, but happily warmed with many homely touches of his humanity and lovable character. The two great positions which he adorned had inevitably a tendency to separate him from his fellows, a differentiation already marked by his great abilities and learning, but to those who knew him personally he was a charming, faithful and affectionate friend. To all men his life was indeed a noble example. G. N.

The Botanist in the Garden

The Living Garden:
or the How and Why of Garden Life. By Dr. E. J. Salisbury. Pp. xi+338+17 plates. (London: G. Bell and Sons, Ltd., 1935.) 10*s*. 6*d*. net.

FIFTY years ago botany, so far as the class-room was concerned, was very much a matter of definitions, just as field botany was concerned almost wholly with the making of a herbarium of local species. The student found himself set to learn a new language—dichasial inflorescences, gynandrophores, campylotropous ovules—as though designed to inculcate the advantages of a classical education. This conception survived pretty well to the end of the nineteenth century. Towards the close of the 'nineties, when examining a school which professed botany, and turning over the notebooks, I found this sentence, evidently taken down by the whole class from dictation, or rather copied from the blackboard, for the spelling would otherwise have offered variants: "Amaryllis—fruit a bilocular loculicidal capsule, a diplotegium". One of my co-examiners breathed his gratitude that he had been introduced to the lady under a happier star and had been learned instead "to sport with Amaryllis in the shade".

As a youngster keen on wild flowers and tasting all sciences that came within reach, I made two attempts to read botany, but each time fell back repelled by the mere cataloguing that was presented for study. It was only on reading Darwin, and in a lesser way Lubbock and Grant Allen, that one discovered a purpose in plant structure; the translation of Sachs appeared in 1875, and with it botany was reborn as the study of the living plant.

Then as time went on and I became more and more engrossed with the wholesale aspects of plant nutrition in agriculture and horticulture, I began to pick up a notion or two about plants of all kinds—wild as well as cultivated. I was always hoping that someone would produce a British 'flora' that would tell me not merely the habitat of a given plant but also whatever was known about its mode of life; how the *Colchicum* remakes its corm every year, how the *Arum* works the flytrap and uses contractile roots to draw its seedlings down to the proper depth. That 'flora' is still to seek, but Prof. Salisbury has produced for the garden the very thing I had dreamt of for the wild. It is a book not only for the young botanist or the gardener who is trying to obtain a scientific foundation for his art, but also for that ever-increasing number of intelligent amateurs who want to have an understanding of their garden and to find a reason for the practices that the professionals inculcate.

Prof. Salisbury begins by telling what the soil does, and then expounds the prime fact that the plant is a machine driven by light, able to move in one direction or another in response to differences of illumination. In his excellent discussion of the natural history of a lawn, he explains how the leaves of the rosette plants—the plantains and dandelions—press downwards because of the more

rapid growth of the illuminated upper surface. Has he ever noticed how these plants will be found sticking upright after the removal of a marquee that had been erected on a lawn for a couple of days? The effects of cold, frost and fog are dealt with at length, though he seems to hesitate a little between the winter killing due to sheer cold and the more usual destruction due to drying out when the soil temperature is too low to allow the roots to function. A mulch of stable manure over the lower part of a tea-rose cannot keep it warm, but prevents a dangerous loss of water.

There are very useful chapters on root development ("The Garden under the Soil"), and on vegetative propagation, which discusses the rooting of cuttings, budding and grafting, with a digression on graft-hybrids and chimæras, where Prof. Salisbury might have extended his illustrations to the relatively frequent cases of chimæras in the variegated hollies, *Euonymus*, and privets of our shrubberies. There is a delightful chapter on the "Spring Emergence"; how the shoot may form a spear that can push through a gravel path or even a layer of asphalt. The chapter on the sources from which our garden plants have been brought might bear expansion, though it would be difficult to know where to stop with so fascinating a subject. Again, the chapter on fertility and inheritance, which begins with an excellent account of the process of fertilisation, might well be extended. So many amateurs want to know a little more about the raising of new varieties, hybridisation and selection. The germination of seeds is well treated, and will introduce to many readers the fact that an initial chilling or freezing may be helpful in inducing 'difficult' seeds to start. The sequence of events during the year, and the daily responses to the rhythm of temperature and light, provide material for another stimulating chapter, and the book concludes with a discussion of the end of the chain—the death of the individual—a remote conclusion with some plants since the Saffron crocus, the actual individual, for the countless corms form but one clone, must be more than four thousand years old.

The book is delightfully illustrated with photographs by the author and with drawings by Mrs. Caroe, which bring out the points at issue as well as any diagram, but yet preserve the aspect of the plant and are enjoyable as drawings. Altogether Prof. Salisbury has produced a notable book; the critical reader may demur to a statement here and there, and have an illustration or two to suggest; let him send them to the author for the benefit of future editions. Finally, let us hope that Prof. Salisbury's book may be the means of leading some of our young botanists out of their laboratories into the garden.

A. D. HALL.

Origin of the Solar System

The Solar System and its Origin
By Henry Norris Russell. Pp. vii+144. (New York: The Macmillan Co., 1935.) 8*s*. 6*d*. net.

THE spectroscopic study of the planets has made great advances in the last ten or fifteen years, and in the present book a distinguished astrophysicist gives a summary of the results and their application to the problem of the origin of the solar system. We now know that Neptune's rotation is direct, though the revolution of its satellite is retrograde, so that the satellite must be approaching the planet, like Phobos. The temperatures of the planets have been measured and found to be in fair agreement with those that would be maintained by solar radiation; the surfaces of the great planets are at liquid air temperatures or less, as was predicted by me in 1922. The compositions of the visible parts of the sun and planets are now known; the great planets have atmospheres consisting mainly of ammonia and methane, and Venus one of carbon dioxide.

Prof. Russell shows that these results are such as would be expected if the planets had been generated at high temperatures from the sun, the lighter ones losing their volatile constituents at an early stage owing to their small gravitation. At this point he overlooks a difficulty about the compositions of the terrestrial planets. The increase of density towards the centre of the earth is too great to be attributed to compression, and demands a large central core of some heavy material, probably iron. But the densities of the moon and Mercury forbid such a core of any appreciable size; Venus resembles the earth, and Mars is intermediate. It is very hard to see how the moon and Mercury can have lost all their iron and retained silicates, and this seems to me to be a great difficulty in every theory of the origin of the solar system yet proposed, not excepting my own. The author devotes a good deal of attention

to the comets, but reaches no definite conclusion as to whether they originated within the system or outside it.

The last third of the book deals with theories of the origin of the planets, and is a very careful and critical treatment. It may be said at once that every theory has to meet a difficulty of the same type: all require some agency to separate the planets from the sun or the parent nebula, and all need to explain how the planets managed to hold themselves together immediately afterwards. Disruption has to be followed by condensation in any case, and while it is fairly easy to make theories to explain either separately, it is very hard to make one cover both. All forms of the nebular theory fail completely here. The tidal and collision theories, while very incompletely worked out, offer some hope, not that the whole of the ejected matter would be condensed, but that enough of it would be retained to make planets of reasonable sizes.

Prof. Russell insists on p. 109 that the resisting medium (formed of the escaped constituents), which the last two theories use to explain the later rounding-up of the planetary orbits, would be collected by the planets. This seems to me definitely wrong. Such a medium would have to be mainly hydrogen, with a density of the order of 10^{-15} gm./cm.^{3}, and a mean free path of some kilometres. He considers seriously the possibility that the free path may be long compared with the diameters of the planets, for which I can see no justification. But his main point is that molecules of the medium would be entangled in the atmosphere and ultimately added to the body of any planet influenced by them. It seems to me, on the other hand, that close to each planet the ordinary theory of gaseous atmospheres must apply. There will be a definite limit to the density attainable, and any addition will be prevented by elastic forces. How great this limit would be depends on the general motion of the medium as disturbed by the planets, which offers a definite though still unsolved problem of hydrodynamics. Permanent addition to the body of the planet requires something to combine with the gas and give a liquid or solid; only oxygen appears to be available for the purpose, and much too little of that; besides, the earth seems to be the only planet that can ever have had an appreciable amount of free oxygen in its atmosphere. It would be expected that the density of the medium near the planets would be greater than elsewhere, but not that this excess would increase indefinitely with the time.

Prof. Russell gives what looks like a serious objection to the tidal and collision theories when he considers the angular momentum that would have to be communicated to the ejected matter. He points out that the angular momentum is closely connected with the perihelion distance; it is strictly connected with the semi-latus rectum, but in elliptic orbits this can range only from one to two times the perihelion distance. Consequently the original perihelion distances of the planets must have been at least half the present ones. But the original supply of angular momentum can be attributed only to friction during the passage of the star and to transverse attraction while the star was within a distance of a few solar diameters, and it is difficult to see how the distance of the matter from the sun at this stage can have been more than a few times the sun's diameter.

If this objection is valid, and I can see no reply at present, we have no satisfactory theory of the origin of the solar system. The objection is in the opposite sense to the one that various writers have made to the nebular hypothesis; the conditions needed to make this hypothesis lead to disruption imply too much angular momentum in the system, while those needed for the tidal and collision theories imply too little. We cannot escape by assuming a greater diameter for the sun at the time, for it is now clear that the sun 2,000 million years ago must have been in very nearly its present state. Incidentally, this point disposes of the nebular hypothesis by itself.

Towards the end of the book, Prof. Russell considers the possibilities that the sun may have been a binary or a nova when the planets were formed, but shows little satisfaction with either.

The book was printed before the publication of the recent theory of Lindblad[1]. There seem to be objections to this theory also, but it contains at least one feature that calls for attention. Previous theories considered the primitive planets and satellites as held together only by gravity. But if the pressure of a gas exceeded the vapour pressure corresponding to the temperature at the surface of a solid, the gas would proceed to condense on the solid, however small the latter might be. Such a mechanism may well account for the formation of meteors in interstellar space, and should be relevant to part of Russell's book. But if the planets were formed in this way it is difficult to see how their orbits failed to be perfectly circular from the start.

It appears that the problem of the origin of the solar system is still unsolved; and perhaps the intermediate stage covered by the resisting medium and tidal friction is the most hopeful for investigation at present. Prof. Russell's book will be indispensable to all interested in our system.

HAROLD JEFFREYS.

[1] NATURE, 135, 133–135, 1935.

An Introduction to Atomic Physics

By Dr. John Thomson. Pp. ix+228+4 plates. (London: Methuen and Co., Ltd., 1935.) 10*s*. 6*d*. net.

THIS clear and systematic presentation of the fundamental facts and theories of atomic physics consists of three parts, each complete in itself. The first part deals with the experimental basis of the subject; starting with the atomic nature of electricity and the carriers of the atomic charge, the composition of the elements is developed with special reference to the contribution of the mass-spectrograph and Wilson cloud-track methods. The elementary quantum is introduced through Einstein's photo-electric equation and Millikan's verification, after which the work of Planck, and the quantum in X-rays and spectral series are described, concluding with a survey of critical potentials. Part II, on the theory of atomic structure, opens with a detailed survey of the Bohr atom, the deficiencies of which lead to a systematic derivation of the Hamiltonian functions used in general dynamics, as an introduction to a good account of the Schrödinger and de Broglie wave mechanics. This is illustrated by detailed application to the hydrogenic atom and to the theory of radiation. The compression of such a survey of wave mechanics into 40 pages naturally presupposes a good knowledge of mathematics. Part III is devoted to further applications and to molecular, atomic and nuclear radiations. Each part ends with a short summary, and an appendix gives a simple derivation of the leading results of relativity theory as used in atomic physics.

The author's aim is stated to be "to help the reader to gain a clear idea of the essential simplicity of atomic phenomena, and to see in their proper perspective the new principles which modern investigations have brought into being". There can be little doubt that this aim has been very satisfactorily fulfilled so far as the more advanced reader is concerned; in addition, there has been compressed into an easily accessible and digestible form a vast amount of modern experimental and theoretical work.

N. M. B.

Albert Einstein:

a Picture of his Life and his Conception of the World. By David Reichinstein. Pp. 255. (Prague: Stella Publishing House, Ltd.; London: Edward Goldston, Ltd., 1934.) 12*s*. net.

As an intimate friend of Einstein, the author of this work is in a position to reveal some interesting details of Einstein's life and mental outlook. The great scientific work of the founder of general relativity is thus placed in its proper setting as an aspect of the remarkable development of its author. The liberal spirit of Prof. Einstein is stressed; and in giving an account of his clashes with Prussianism and Nazism, Prof. Reichinstein shows much feeling for the persecutions to which Einstein has been subjected by his fellow-countrymen. There is little doubt that this book is a valuable source of information for any future biography of Einstein. T. G.

Potlatch and Totem: and the Recollections of an Indian Agent

By W. M. Halliday. Pp. xvi+240+24 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1935.) 15*s*. net.

MR. HALLIDAY has a personal experience of the Indians of British Columbia which goes back to 1873. He has been in personal contact with them for thirty-eight years, of which twenty-six were spent in charge of the Canadian Government Indian Agency of the Kwawkewlth (Kwakiutl), of Vancouver. His reminiscences of Indian custom fall into two parts. In the first, he describes an imaginary potlatch ceremony, that remarkable custom by which position and prestige was made to depend upon the lavishness with which gifts were distributed by the head of a clan at a feast; and in the second he records such of his experiences among, and impressions of the Indians, while acting as a Government official, as will serve to throw light on Indian character and mentality as expressed in religious belief, attitude to law and authority, and achievement under the white man's system of education. Mr. Halliday's views on racial origins are not to be taken seriously.

The author's outlook is that of a sympathetic official, whose duties and views of Indian character and custom coincide. Thus the potlatch, now forbidden by law, is regarded as detrimental to the interests of the Indian, because, involving a return with interest, often so high as two hundred per cent, it reduced the individual and his immediate group to penury, and was an increasing burden on the community. His account of the institution, however, is sufficiently objective to make it obvious that the potlach was the integrating factor in the community, and its abolition the death knell of Indian tribal society. The Indians themselves, or at least the younger men, being shrewd and progressive, welcomed a change which set them free from tribal obligations. The tribal disintegration which has followed is a typical example of the results of the application of White philanthropic and moral ideas to the administration of the affairs of a non-European culture. That the results in this instance have not been universally unfortunate is to be attributed to a sympathetic administration, as well as to the abilities and character of the Indians themselves, though the author is inclined to assign their achievement to the infusion of white blood.

Law and the Social Sciences

By Huntington Cairns. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xiv+279. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1935.) 12*s*. 6*d*. net.

WHAT comes out clearly in Mr. Cairns's study of the relations of jurisprudence to anthropology, psychology, political theory, economics and sociology is that law, regarded more especially as the judicial process, has become increasingly sociologically minded, and that if it is to achieve full power in ordering human society, "it must join with the other

social sciences in a united effort to solve the problems common to all". These are not novel conclusions, and yet the task the author set himself was well worth doing. For it is often forgotten that only as late as the sixteenth century did jurisprudence escape from theology, philosophy and ethics, and became a separate discipline. This emancipation was undoubtedly necessary at the time. But once achieved, it became even more necessary, with the growing complexity and interconnectedness of society, to bring law back into the totality of social life. Society is one, and each of the social sciences, including law, studies and attempts to manipulate but one aspect of it. They cannot therefore remain isolated from each other if they are to be useful instruments for theoretical understanding and practical manipulation.

Every topic here touched upon would require a separate volume for full treatment, and it says much for the author's wide reading and large equipment that he has been able to concentrate so much in such a narrow compass. At the same time, a certain discursiveness and lack of criticalness (see, for example, the discussion on intelligence tests and criminal responsibility) are evident, and no doubt the author would be the last person to claim that he has exhausted the field. The book is a pioneer work, and from that angle deserves close study.

J. R.

The Dorset Coast: a Geological Guide

By G. M. Davies. Pp. vii+126+8 plates. (London: Thomas Murby and Co., n.d.) 6*s*. net.

PRACTICALLY the whole of the Dorset rock consists of formations of Mesozoic age, and it has, moreover, a wonderfully extensive and various catalogue of fossils. Whereas one may traverse the greater part of Cornwall without finding fossils at all, here in Dorset one cannot go into any little bay or cove without finding an abundant and extensive fauna. Few portions of our Jurassic rocks can be studied in such detail and admirable sequence as the Dorset coast line, which forms a very distinct opposite to the neighbouring coast of Devon.

The numbers of photographs in this book, and the meticulous care with which these have been chosen, and the care with which various details have been picked out, all add immensely to the value of the book.

We regret that so little has been said about the Chesil Bank, which still remains a problem. The Palæozoic pebbles are by no means so few as Mr. Davies suggests, and their persistent appearance has yet to be explained. For even supposing these erratics to have travelled all the way from their home in the St. Just cliffs, just around the Land's End, it still remains a problem as to why they should be piled up here, and yet why the beaches of Cornwall and South Devon contain so few.

We heartily congratulate Mr. Davies on having produced a book the clearness and simplicity of which make it a pleasure to read. Not only the tyro in geology but also many a professional geologist will take this with him when he travels the Dorset coast.

F. J. STEPHENS.

A World Production Order

By Dr. F. M. Wibaut. Translated from the Dutch by R. W. Roame. Pp. 240. (London: George Allen and Unwin, Ltd., 1935.) 6*s*. net.

THERE is much in this unpretentious book to commend it to the attention of the scientific reader. Its indictment of our present system of production and distribution as obsolete and inadequate, leading to a chronic condition of chaos in which unemployment on a large scale is endemic, is characterised by common sense and moderation. No less noteworthy for the complete absence of denunciation and class hatred or bitterness is its condemnation of the private monopolies which are the inevitable result of the present system and which control, in their own interest only, prices of the necessities of life. Its resolute attempt at fundamental thinking on the situation and to secure the economic conditions which will enable the scientific and technical triumphs of mankind to benefit the whole race has a sure claim on the sympathy of scientific opinion, and this claim is reinforced by the many years of administrative experience in Amsterdam from which Dr. Wibaut is able to speak.

Dr. Wibaut sketches for his readers no Utopia, nor does he make the mistake at this stage of outlining ways and means too closely. He defines with some certainty a fundamental change in the world's organisation and the improvements required to effect that change. He indicates too that in the League of Nations and the International Labour Organisation there already exist the germ of international and national councils and institutes required for building up ordered production on the basis of democracy. He is most concerned, however, to provoke thought, above all creative thought, through which alone can be worked out the details of a new production system based on the collective satisfaction of human needs.

The Geographic Pattern of Mankind

By John E. Pomfret. Pp. xv+428+22 plates. (New York and London: D. Appleton-Century Co., Inc., 1935.) 15*s*. net.

DR. POMFRET views his 'geographic pattern' as an essential background for the comprehension of economics, politics, history and the other social sciences; and in surveying the modern world as composed of areas each exhibiting a preponderant type of climate or physiographic influence, he consistently maintains this point of view. His aim is to show in detail how this main factor has determined the social organisation, utilisation of resources, character of industries and type of occupation, incidentally bringing out with no little point and emphasis the differences in character and achievement of regional forms of culture which have developed under these varying influences. The differentiation, social and psychological, of China and Japan, or the characterisation of South America, with particular reference to its economic and political development, may perhaps be regarded as particularly successful examples of his understanding of the interplay of the forces involved.

The Deep-Water Circulation of the Indian Ocean

By A. J. Clowes and G. E. R. Deacon

UNTIL very recently, it has been generally assumed that the deep-water circulation in the Indian Ocean was very similar to that of the Atlantic; in certain features, such as the Antarctic bottom current and the Antarctic intermediate current, the close resemblance between the two oceans is still undisputed. It has, however, been suggested that the north Atlantic deep current—the highly saline deep current which Merz and Wüst (1922, p. 23) showed to flow southwards between the intermediate and bottom currents in the Atlantic Ocean—has no parallel in the southern part of the Indian Ocean.

The existence of a southward deep current of highly saline water in the northern part of the Indian Ocean was demonstrated very clearly by Schott (1926), Matthews (1927) and Möller (1929), and it was found to be composed of highly saline surface water sinking from the coastal regions of the Arabian Sea and the neighbouring gulfs, particularly from the Red Sea. The observations made by the *Challenger*, *Valdivia*, *Planet* and *Gauss* also showed that there was a highly saline warm deep layer in the Antarctic and sub-Antarctic regions; and since the data from the intervening part of the ocean were very scanty, it was reasonable to suppose that the warm deep layer found in the south was a continuation of the deep current which spreads southwards from the north. It was therefore assumed by L. Möller (1929, p. 37) that the north Indian deep current filled the deep layer in the western part of the Ocean with water of salinity more than 34·80 per mille almost as far as the Atlantic-Indian cross ridge in about 50° S.

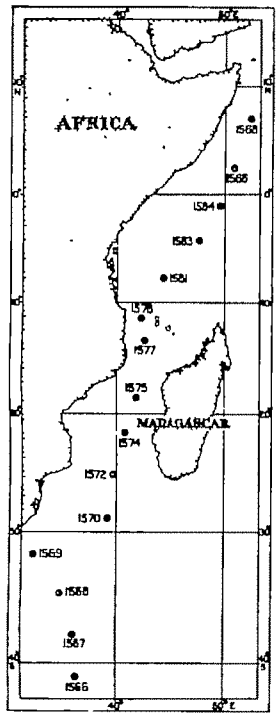

FIG. 1 Chart showing positions of hydrological stations made by the R.R.S. *Discovery II* in April 1935.

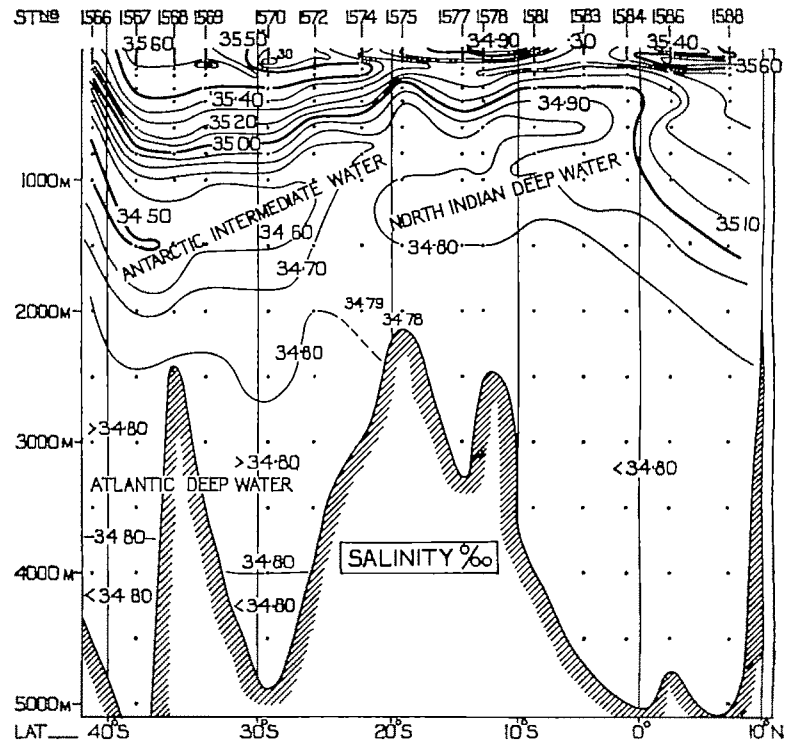

FIG. 2. Salinity at the stations shown in Fig. 1.

Thomsen (1933) has, however, used the observations made by the *Dana* (1932), and the *Willebrord Snellius* (1932) in the southern tropical and subtropical parts of the ocean to show that the assumption that the highly saline deep layer in the south was a continuation of the deep current in the north was, after all, not justified. He found that the north Indian Ocean deep current did not carry water with a salinity greater than 34·80 per mille south of a line from the northern end of

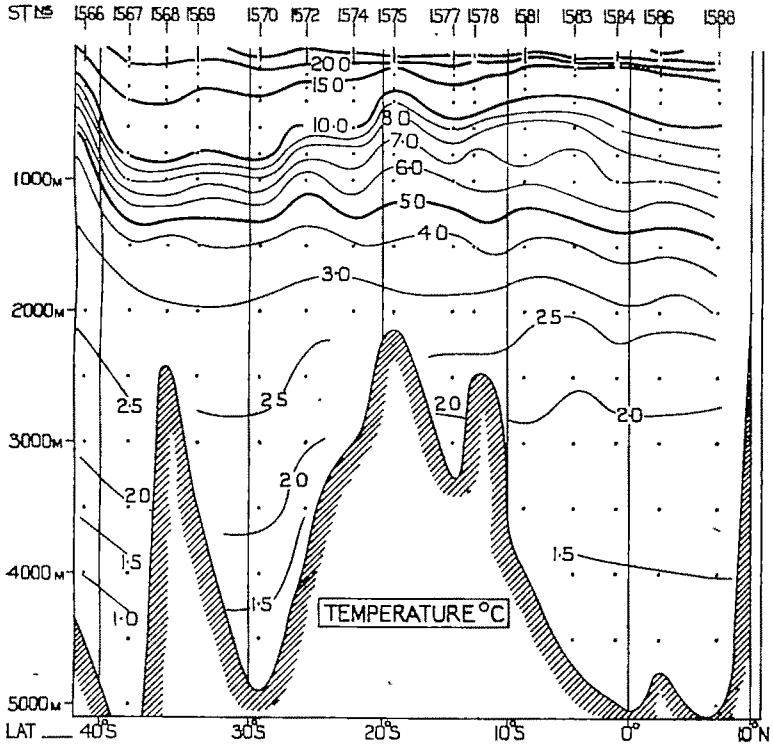

FIG. 3. Temperatures at the stations shown in Fig. 1.

Madagascar to Ceylon. L. Moller (1933) was not convinced that the new data which Thomsen used justified at present a reversal of her former conclusions. In a later paper, Thomsen (1935, p. 299) states that at stations on a line between Ceylon and Cape Delgado he found no traces of a deep current between 2000 m. and 3000 m., but that it is possible that a rudimentary, southerly-directed current exists with a nucleus at about 800 m. in the north and about 1200 m. in the south.

Further light has been thrown upon the problem by a series of observations made by the R.R.S. *Discovery II* in her recent voyage from the Antarctic in 1935 on a line from Marion Island through the Mozambique Channel to the Gulf of Aden. The positions of the stations and preliminary salinity, temperature and oxygen content sections are shown in Figs. 1–4. The north Indian deep water is clearly distinguished at the northern end of the sections by its high temperature and high salinity, and low oxygen content. The salinity section (Fig. 2) shows that it has a salinity of 34·80 per mille as far as 20° S. approximately. South of this latitude there is a second body of highly saline water with a salinity of more than 34·80 per mille, but it is clear from the salinity, temperature and oxygen content that this second body of highly saline water is not merely a continuation of the north Indian deep current. It is approximately 2° C. colder and 2 c.c. per litre richer in oxygen, and is therefore derived partly from another source, plainly from an eastward current of Atlantic deep water. The existence of such a current is in fact generally agreed upon. It was inferred by Merz and Wüst (1922, p. 23) from the temperature chart for 1500 fathoms given by Buchan (1895) in the *Challenger* reports, and also recognised by Wüst (1926, p. 250) and Möller (1929, p. 37).

Although there is this body of Atlantic deep-water in the southern part of the sections, our observations suggest that the north Indian deep current does not come to a sudden termination in 20° S. The oxygen

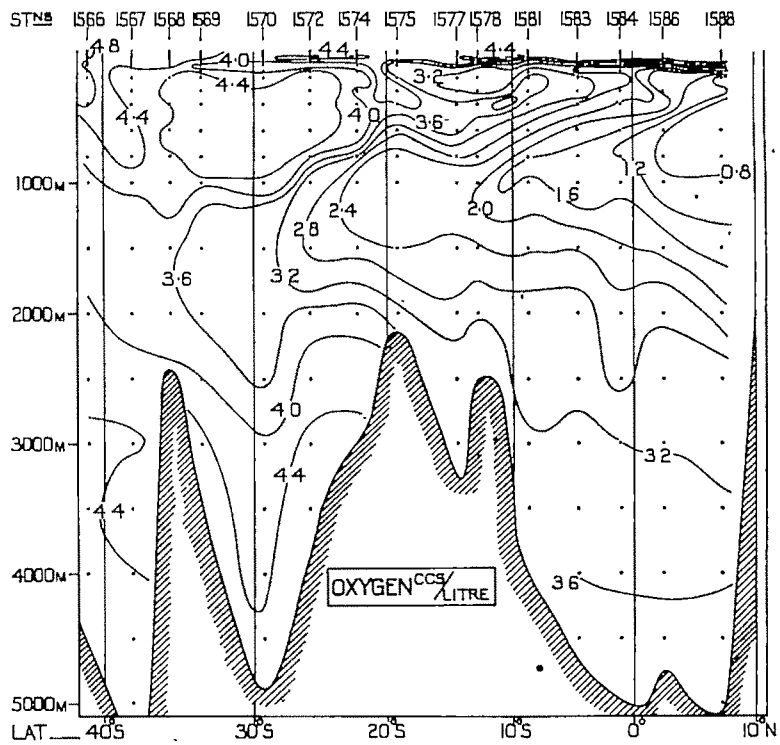

FIG. 4. Oxygen content at the stations shown in Fig 1

distribution, especially, suggests that the north Indian deep water flows much farther south in the upper stratum of the warm deep layer, sandwiched between the Antarctic intermediate current and the Atlantic water. A chart of the oxygen distribution in the warm deep layer in the southern part of the Indian ocean, to be published in a forthcoming report by one of us (G.E.R.D.), shows that south of Africa the oxygen content of the deep layer falls rapidly towards the east, indicating that the Atlantic water is joined by a southward movement of water containing less oxygen from the northern part of the Indian Ocean.

A comparison of our section with that of Möller (her Mozambique section is along almost the same line as ours) suggests that the volume and salinity of the north Indian deep current are subject to large variation, probably related to the changes of salinity in the coastal regions and to the current differences brought about by the changes of the monsoon winds and variation in the south Equatorial current. The observations of the *Valdivia* and the *Ormonde* used by Möller show that the deep current fills the northern part of the Ocean with water of 35·00 per mille salinity as far as 8° S. and to a depth of 2000–2500 metres, while our section (Fig. 2) shows that this isohaline is not found south of the equator or deeper than 1500 metres. A strict comparison cannot be made between Thomsen's and our section, since his is much farther east than ours, but the volume of the deep current seems to have been less when his observations were made, since he did not find the 34·80 per mille isohaline south of a line from Ceylon to Cape Delgado (1933, p. 78), whereas we found it to extend as far as 20° S.

Thus, as a result of the recent observations of the R.R.S. *Discovery II*, the extent of the southward flow of the north Indian deep current appears to be a compromise between the views of Möller and Thomsen. Oxygen observations in particular show (Fig. 4) that this current can be traced southwards as a tongue of poorly oxygenated water sandwiched between Antarctic intermediate water and an eastward current of north Atlantic deep water.

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A Century of Botany*

1835—1885—1935

By Prof. F. O. Bower, F.R.S.

IN 1835 Glasgow already possessed a botanic garden, which had been established in 1818 by Royal Charter. In this same year, the regius chair had also been founded. It was occupied in 1835 by its greatest tenant, Sir William Hooker, who after holding it for twenty years became, in 1841, the first director of the Royal Botanic Gardens at Kew. He was succeeded in that office by his son, Sir Joseph Hooker, who had been educated in this University. Thus Glasgow may be held as the cradle of the national establishment. Under the care of the professor, the Royal Botanic Garden of Glasgow had become a centre of high horticulture, and of the distribution of rare plants, many of them new to science. But there was in 1835 no Department of Botany in the old College. There were no laboratory, botanical museum, herbarium, or library, beyond what Hooker himself possessed, which was accommodated in his own private house. So when he was appointed as the first Director of Kew in 1841 he naturally took his collections with him, leaving the University wholly denuded; though Kew itself absorbed thus the finest private collections in the country.

A brief survey may be made of the state of botanical science in the world at large in 1835, when Sir William Hooker was in his fifteenth year of office at Glasgow, and in the full plenitude of his powers as a man of fifty. Nothing can be more revealing of the time than that while it was pre-evolutionary, it was also pre-protoplasmic. Though plant anatomy was well advanced, with

* From an address delivered on November 8 in the University of Glasgow by invitation, in celebration of the jubilee of Prof. Bower's appointment as regius professor of botany (April 1, 1885) and of Prof. Bower's eightieth birthday (November 4, 1935).

its foundations securely laid by Hooke and Grew in the seventeenth century, and though their observations had been extended in the eighteenth by the phytotomists of the Continent, it was only the scaffold of cell-walls that they knew: the vital body which those walls enclosed was almost wholly missed. Before 1835, sporadic allusions had already been made to a transparent slimy substance contained within the cell-walls. Interest had been taken in the movements of granules within it, and suggestions made of vital motion. But it was only in 1831 that the nucleus was first recognised by Robert Brown as a body of general occurrence in the cells of plants: while the structural correspondence of the cell contents with the sarcode of animals was first published by Schwann in 1839. Finally, it was not until 1846 that the word 'protoplasm' was introduced by von Mohl, to connote that "viscid fluid—of white colour—which occupies the cell-cavity". Thus the year 1835 fell within that short nascent period when the physical basis of life was emerging from obscurity towards definite visualisation, making modern physiology for the first time possible.

On the other hand, 1835 fell within the heroic age of scientific exploration: and Glasgow, through Sir William Hooker's son Joseph, took her full share. We may well hold the years from 1831 when the *Beagle* sailed with Darwin on board, or 1839 when Ross, with Joseph Hooker as a young medical officer, penetrated the Antarctic with the *Erebus and Terror*, to 1851 when Joseph Hooker completed his Indian journey—or better still 1852 when Wallace returned from the Amazon—as its golden period. Discovery was then in the air, with its handmaids collection and record. It opened with a tacit acceptance of the fixity of species, but it bore within the germ of evolutionary theory. Sir Joseph, in working out his circumpolar collections into the Antarctic flora, gave in 1859 expression to his belief in the mutability of species. This was the year of publication of Darwin's "Origin of Species". Sir Joseph was in fact the first of the great group who stood round him. Thus not only did 1835 fall within the nascent period of evolution, but also an alumnus of Glasgow, son of the some-time professor of botany, was himself deeply involved.

Sir William, however, belonged to a prior age. He never publicly committed himself to the later view of the mutability of species. He was essentially an old-fashioned systematist, with a particular leaning towards the mosses and ferns. He had already published his "British Jungermanniaceæ" in 1816, as well as important memoirs on mosses. But it was during the period in Glasgow that he produced with Greville the sumptuous "Icones Filicum" (1851), and with the artist Ferdinand Bauer the preparatory work was being done there for the "Genera Filicum" (1842). Later came the "Species Filicum" (1846–64), a work which was finally condensed into the "Synopsis Filicum" (1865). These and other of his writings established Sir William's position as the leading systematic authority of his time on the Archegoniatæ. But he was also a general botanist, whose personal influence moulded the scientific establishment at Kew. Robert Brown still reigned at the British Museum. The effect of their work spread to the universities, with the result that between 1835 and 1885 descriptive and systematic botany held the field in Britain.

My second date, 1885, also marks a nascent period, but the conditions were very different from those of 1835. The intervening half century had brought in Britain, as the result of foreign travel, great accessions to its herbaria. The systematic treatment of these, particularly as published in floras of the British possessions, had occupied the time and capacities of our professional botanists to such a degree as almost to paralyse efforts in other branches of the science. Not only Kew and the British Museum, but the universities as well, were drawn into the floristic vortex. In Glasgow itself a notable result was the "Flora Indiae Orientalis", in which Prof. Walker Arnott described the rich Indian collections made by Wight. It was published in their joint names. But, meanwhile, on the Continent, and particularly in Germany where imperial demands were not so pressing, laboratories private and public were opening. The branches of minute anatomy, physiology and development of plants were advancing rapidly. In particular, Schleiden, Hofmeister, Naegeli and Pringsheim were laying afresh the foundations of morphology, broadly based upon the study of anatomy and developmental life-histories. Physiology was rejuvenated under the genius of Sachs. Tulasne and De Bary were meanwhile establishing a new cult of mycology, while Bornet and Thuret were doing the like among the algæ. Our own universities, however, concentrated their botanical teaching in the 'sixties and 'seventies upon the classes for medical students. The professors based their rather limited syllabus not on the biological side of the science so much as on the floristic and pharmaceutical. The idea of tropical forests and desert islands, of Crusoe and the Swiss Family Robinson hovered in the background. There were before 1870 no botanical laboratories in the British universities. Floristic and systematic botany, with dashes of pharmacy, morphology and economics made up the usual fare offered to the student. The individual professor might take what

special branch of study he pleased: but this rarely filtered through, as a private act of grace, to the individual pupil. In point of fact, Britain had fallen behind in all branches excepting systematic botany, in which she excelled.

The revival of biology, and of its branches of zoology and botany, was initiated in Britain by Huxley, Michael Foster and Thiselton-Dyer: but an important preliminary step was taken by Dean Farrar, himself at the time a public-school master. He advocated the teaching of science in schools, at the British Association meeting at Nottingham in 1866, with Huxley in the chair. Little result followed at first in the old public schools or in the universities. It was, in fact, through the national schools that the revival began. If science was to be taught there, the teachers must themselves be taught first. This led to the classes for teachers at South Kensington, organised under Huxley from 1871 onwards. The essential feature of his method was a daily preparatory lecture, followed by personal observation by each student. Thiselton-Dyer undertook the botanical side and Vines, originally a medical student in London, assisted him: by his election as a scholar of Christ's College, Vines formed the connecting link with Cambridge. Marshall Ward soon stood out among the early pupils at South Kensington, and later he also was entered as a scholar of Christ's. He and I, as fellow students at Cambridge under Vines, soon found places on the demonstrating staff to the summer classes at South Kensington.

This revival in the 'seventies spread with varying success to the English universities: but Huxley's methods caught on less readily in Scotland. The northern lag was, however, made up in Glasgow by the appointment of Bayley Balfour, fresh from foreign travel and visits to German laboratories, as professor of botany there in 1879. When I succeeded him in 1885, also having experience of foreign universities, and after three years' experience as lecturer at South Kensington, elementary practical classes of Huxley's type were already in being in London and elsewhere for the study of the 'New Botany': my duty was to develop them in Glasgow.

All this sounds very easy now: but the revival that spread from South Kensington found opposition like any other missionary effort. "The Cause", as Marshall Ward used to call it, involved a change over from the dead to the living plant: from the herbarium, supported by study in the garden and field, to observation at the laboratory table by each student himself. Structure, function, development and life-history were to be examined, and that not only in flowering plants, but in the cryptogams as well.

In 1885 there were in the Scottish universities no faculties or degrees in science: nor were there any advanced classes under ordinance. In Glasgow, botany was studied officially only in the summer. Not only was the time then devoted to botany in Glasgow limited, but also the space available for its study. The Department in 1885 consisted of two small rooms used as voluntary laboratories, and dusty attics for the herbarium. There was no lecture room, but such as could be borrowed from another department. I paid my own assistant and laboratory attendant. There was no official staff, not indeed any department at all in the modern sense. In theory this was corrected under the Act of 1889: nevertheless, for sixteen years after my appointment the accommodation remained the same. It was not until 1901 that the new building was opened.

Great as were these official and material defects in Glasgow in 1885, that date again fell within a nascent period in the history of botany in Britain. The first English edition of Sachs's "Textbook" had been published in 1875: the translation of De Bary's "Anatomy" followed in 1884, and that of Sachs's "Lectures on Physiology" in 1887. Thus the student of the British revival was supplied with fresh textbooks. His observational work was also vivified by the experience of teachers who had studied personally under these great men. Beyond this, many new starts were already in the air. Tangl had demonstrated in 1880 the continuity of protoplasm from cell to cell, and Gardiner extended these results so that Sachs found himself able in 1882 to state that "every plant, however highly organised, is fundamentally a protoplasmic body forming a connected whole".

On the other hand, in 1874, Schwendener had given a new aspect to anatomy by demonstrating the mechanical principles that underlie structure: while Haberlandt further stimulated the functional study of tissues by his "Physiologische Pflanzenanatomie" of 1884. At the same time, from the Buitenzorg garden, Treub was revealing the wonders of Lycopod embryology, with their bearing upon the morphology of the Archegoniatæ. At Bonn, Strasburger had already laid the foundation for cytology by his inquiry into the minute details of nuclear division. The third edition of his "Zellbildung und Zelltheilung" had appeared in 1880, while statistical hybridisation, the experimental correlative of nuclear division, had already been initiated by Mendel in 1865, though the world did not know of his results until 1900. Finally, it was in 1885 that Weismann's pronouncement on germplasm was published. Thus at our second period many new lines of advance were being opened up.

Such was the developmental phase of the science of botany when I accepted the Glasgow chair in 1885. Botany was no longer a valley of dry bones: a progressive and living aspect had been given to it. But at Kew and the British Museum great systematists still upheld the old classificatory traditions: and there appeared to be some danger of British botanists separating into two camps—as systematists or as physiologists. On the Continent, however, an ameliorating influence sprang from the work of Warming, who combined under the name of ecology the records of function and of distribution: thus presenting to systematists a living aspect of their study. Here at home Sir Joseph Hooker was the Colossus who had a foot down in both camps. It was, in fact, a forecast of ecology that he had practised in the Antarctic. But he was never a teacher, nor did Kew compete with the colleges, which had drifted off with a dangerous and almost exclusive bias towards the 'New Botany'.

(*To be continued.*)

Progress of Food Investigation

As in previous years, the report of the Food Investigation Board for 1934* describes the researches carried out at the various research stations of the Board by the members of the food investigation staff and emphasises the ways in which laboratory results have been applied commercially. Sir Frank Smith was appointed chairman of the Board, in succession to Sir Joseph Broodbank, who resigned; Mr. E. Barnard was appointed director of food investigation and Dr. Franklin Kidd superintendent of the Low Temperature Research Station, in succession to the late Sir William Hardy. That the work of the Board is of value to all parts of the Empire has been signally recognised by the contributions made by Dominion Governments, which amount to nearly £10,000 a year, and show the wide extent to which Imperial co-operation in this field of research has already grown.

The discovery that beef can be stored in the chilled state for 60–70 days when the atmosphere contains 10 per cent of carbon dioxide has quickly led to the importation of considerable amounts of chilled beef from Australia and New Zealand; during 1934, no less than 4,400 tons were imported in gas storage from these two Dominions, and it is now practicable to secure the necessary gas-tightness in the holds. At the same time, the careful preparation of the meat and the hygiene of the slaughterhouse floor are probably of even more importance than control over the conditions of transport.

A number of problems, however, remain for solution, including the correct storage to prevent chafing, and the proper conditions as regards cooling, humidity and air circulation for the preservation to the fullest extent of the natural appearance or bloom of the meat. Loss of bloom is largely due to the oxidation of hæmoglobin to methæmoglobin; the reaction is monomolecular with respect to the concentration of reduced hæmoglobin and roughly monomolecular with respect to the partial pressure of oxygen; the rate is maximal at a partial pressure of about 23 mm. of carbon dioxide. The results show that 10 per cent of carbon dioxide in the atmosphere has a negligible effect, but with this concentration that of oxygen must be increased to more than 60 per cent if the production of methæmoglobin is to be appreciably retarded.

Important developments have taken place during the year in the application of refrigeration to the herring industry. Experiments had shown that herring, although containing much more fat than white fish, could be brine frozen at the usual temperature of −5° F., and would make good kippers after at least five months' storage at that temperature. 800 tons of herrings were then frozen in one of the East Coast factory ships with the view of using them for kippering, for canning and for consumption fresh during the early months of this year (1935) when home-caught herrings are not normally available.

The gas-storage of home-grown fruit has gone on apace. During 1934 the number of commercial gas-stores in Great Britain increased from 12 to 40, and the number has probably doubled in the course of the succeeding twelve months. It has been found that the winter temperatures of English warehouses are too low for the satisfactory ripening of several varieties of imported pears and plums. Conditioning for a brief period at a temperature of 70° F., however, greatly improved the quality of South African and Australian William pears and of South African Kelsey plums. The best conditions for commercial conditioning have yet to be ascertained, but there is little doubt that conditioning will soon be considered essential for the successful marketing of certain varieties of imported pears and plums.

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1934. Pp. 261+x. (London: H.M. Stationery Office, 1935.) 4*s*. net.

The use of wrappers treated with a solution of iodine in potassium iodide has been found to retard the development of fungal rotting in grapes, tomatoes and oranges. Brown rot of plums and peaches has also been reduced by iodised wraps. The appearance and flavour of the fruit are not impaired, nor is ripening hastened. On the other hand, certain varieties of plums and peaches are adversely affected; they fail to ripen properly or may even turn black. When iodine is successful, it is because spores and young mycelium at the critical stage of infection are far more susceptible to its action than are old mycelium and the tissues of the fruit; it can thus be used in concentrations sufficient to retard the development of moulds without causing damage to the fruit.

Further results of interest have been obtained from the continued study of the critical changes occurring in the apple at the climacteric, the most important of which is the identification of the active substance which is given off by apples at their climacteric change, and which itself stimulates this change in other apples. It was identified by absorbing it in bromine at −65° C., afterwards preparing a crystalline derivative identified as diphenylethylenediamine. The suggestion that the active substance is ethylene was, therefore, confirmed. About 1 c.c. is apparently given off during the whole of an apple's senescence.

An accidental discovery of great practical interest was made in the course of gas-storage trials of the 1934 season; a set of ripe, strongly-smelling, post-climacteric apples was included in some of the experimental cabinets among several other varieties in the pre-climacteric condition. The ripe fruit caused a considerable amount of physiological damage to the rest of the fruit in the form of spotting round the lenticels.

Progress is recorded in the study of two common diseases of stored apples, namely, scald and low temperature breakdown. Scald is produced by changes in the tissues of the fruit occurring weeks or months before the injury becomes apparent; prevention by oiled paper wrappers is chiefly efficient during these early predisposing changes. Scald was also almost completely prevented in Newton Wonders stored at 3° C. by brief intermittent warming of the fruit at 15° C. Scald is probably due to an excessive accumulation in the superficial tissues of the fruit of some volatile substance.

Among other points in the report to which attention may be directed is the investigation into the stability of synthetic vitamin C (ascorbic acid) during canning. It was added to runner beans, which do not naturally contain much vitamin C, to spinach and to apples and apple jelly; in no case was the loss greater than 25 per cent during the canning.

This brief summary of some of the investigations described in the report will give some idea of the range of the researches carried out by the Board, and their importance for the nation's food supply.

Obituary

Dr. Griffith Evans

DR. GRIFFITH EVANS, whose death on December 7 we regret to announce, was a pioneer in the study of protozoology in connexion with infections, and the first man to associate trypanosomes with the production of disease. He was born at Tymawr, near Towyn, Merionethshire, on August 7, 1835. After studying medicine for a short time with a medical practitioner at Towyn and Aberdovey, he entered the Royal Veterinary College, London, where he qualified as M.R.C.V.S., and later passed into the Royal Artillery, with which regiment he served in Canada during the American Civil War. During his years of service in Montreal he registered in the Medical Faculty of McGill University, and graduated M.D., C.M. in 1864.

On his return to England in 1871, Evans was transferred to the Army Service Corps and continued his medical studies at King's College, London, and elsewhere until 1877, when he was sent to India. It was there that his great work on blood parasites was carried out. Microscopy had been his hobby since his earliest student days, and an important part of the equipment which accompanied him to India was a portable microstand, the best lenses which he could obtain up to 1/12th immersion, a suitable condenser, etc.

On arrival in India, Evans was appointed to investigate an endemic disease which for many years had been fatal to cavalry and artillery horses; by microscopic examination of the blood, which revealed the specific bacillus in the blood of every patient, Evans at once proved the disease to be anthrax fever. What surprised him most in his investigations was the fact that the first change in the blood seen under the microscope was a great increase in the number of the large white corpuscles before the bacillus could be seen; moreover, when the bacilli came, they appeared to be closer to the white corpuscles than to the red. He reported his conviction that the large

granular corpuscles had an important relationship to the bacilli, though he was unable to prove what that relationship might be. This was in 1878, six years before Metchnikoff discovered them to be phagocytes, and at a time when Evans himself did not know even how to fix and stain microbes in the blood for microscopic observation.

In 1880 Evans began his work on surra. He was requested to proceed to Dera Ismael Khan, where surra had been fatal to horses and camels for many years; and upon studying the reports which had already been made upon the disease he at once reached the opinion that it was due to a parasite of the blood —an opinion which had never before been formed. After much opposition, he gained permission to carry out his investigations with a free hand, to make what experiments he wished upon sick and healthy animals, and to kill the animals at any stage of the disease. His first act was to examine microscopically the blood of a surra patient: it was swarming with parasites. Though Koch had not yet made his classical postulates, and though Evans did not know the nature of the microbes revealed to him, he immediately associated them with the production of the disease. They were the parasites which, at first called *Trichomonas evansi*, are now known as *Trypanosoma evansi*.

Evans at once took steps to show his newly-discovered microbes to Dr. Timothy Lewis, the discoverer of the parasite in the blood of the brown sewer rat—now called *Trypanosoma lewisi*. Without hesitation Lewis declared that the two parasites were, with some slight difference, morphologically alike; but he emphatically denied that they were pathogenic. His rats were, in his opinion, healthy, and he did not believe that Evans's microbes were the cause of surra. Nevertheless, Evans continued his investigations eagerly, seeking to prove that a definite relationship existed between the variable number of the parasites present in the blood and the course of the symptoms. Official opinion was strongly against him. In fact, in Evans's own words, the Surgeon-General, the Chief Sanitary Officer and all the senior medical officers "sat upon me heavily", but the Government printed his reports, and he had the gratification of knowing that his statements spurred on a number of younger men to continue investigations along lines which he had laid down.

Evans returned to England in 1885, and after further work in Crookshank's laboratory, King's College, London, retired from the army in 1890. In 1917 he was awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine, in recognition of his distinguished scientific work, and on that occasion he wrote a short autobiographical memoir, which was published in vol. 12 of the *Annals of Tropical Medicine and Parasitology*. A year later the Royal College of Veterinary Surgeons awarded him its John Steel Medal.

Dr. Griffith Evans celebrated his hundredth birthday in August last, when he was the recipient of a presentation scroll from the Royal Veterinary College and of many congratulatory messages (see NATURE, August 3, p. 173 and August 17, p. 251).

Dr. J. H. Breasted

WE regret to record the death of Dr. J. H. Breasted, the well-known Egyptologist, founder and director of the Oriental Institute of the University of Chicago, which took place on December 2, in the Medical Center Hospital, New York, at the age of seventy years. Dr. Breasted, who had returned to the United States from Italy only a few days previously, was thought to be suffering from an attack of the tropical malaria to which he had been subject for some years; but his illness proved to be due to hæmolytic streptococci, and terminated fatally.

James Henry Breasted was born on August 27, 1865, and was educated at the Chicago Theological Seminary and the University of Berlin. At the latter, he devoted himself particularly to Egyptological studies; and, indeed, the abiding influence of the Berlin school of thought was apparent throughout his work. In 1894, he became assistant in Egyptology in the University of Chicago, and in 1901 was made director of the Haskell Oriental Museum. Among other university appointments, he occupied the professorial chair in Egyptology from 1905 until 1933. His more important activities outside the University included a mission to the museums of Europe in 1900 to prepare documents for the Imperial Egyptian Dictionary for a commission of the Royal Academies of Germany, and the direction in the field of the expedition of the University of Chicago to Nubia in 1905–7.

By the close of the first decade of the present century, Breasted's international reputation as an Egyptologist and an ancient historian stood high, owing in no small measure to his attractive, and at the same time scholarly, "History of Ancient Egypt" (1905), and his excerpts from original documents of the Egyptian historical records, of which he had published five volumes. His strength, however, as was proved by his later activities, was even greater in the organisation of research than in his quality as a research worker. His interests had transcended the bounds of Egyptology and at a comparatively early stage of his career he had begun to formulate plans for a scheme of research into the origins and growth of civilisation on a grand scale, the theatre for its operation—the ancient East—being determined by the fact that here the lengthy span and the continuity of man's existence as a member of organised society could be investigated on archæological sites with a wealth of detail that was impossible in any other part of the world.

These plans did not attain fruition until after the Great War. As the result of an expedition of reconnaissance through the Near East in 1919–20, Breasted mapped out a plan of campaign for research in the field which covered all the main historical, geographical and chronological strategic points in Egypt and Western Asia, extending from the time of palæolithic man in the Nile Valley and Mesopotamia down to the days of the Persian Empire. As a necessary complement and accompaniment was an institute for the interpretation of results and further research at headquarters in Chicago, which so far as library and laboratory work were concerned was to be duplicated on a reduced scale at headquarters

in the field. Thanks to the generous assistance of Mr. J. D. Rockefeller, Jr., who accompanied Breasted on a tour of the chief pivotal sites of his scheme, it became possible to put the plan into operation; and it took material form as the Oriental Institute, which, as Breasted stated, at the time of the formal dedication of its own building in December 1931, in addition to its activities in Chicago, had no less than eleven expeditions at work in the field at one time. The placing of these expeditions in reference to the respective phases of historical and cultural research which Breasted anticipated that each would elucidate, showed a masterly grasp of the essential movements of ancient history, a quality conspicuous in what are perhaps his best known works "The Development of Religion and Thought in Ancient Egypt" (1912) and "A Survey of an Ancient World", "Ancient Times: a Survey of the Early World" (1916), and "The Dawn of Conscience" (1933).

WE regret to announce the following deaths:

Prof. J. S. Mackenzie, emeritus professor of logic and philosophy in the University College of South Wales and Monmouthshire, Cardiff, on December 6, aged seventy-five years.

Prof. Charles Richet, professor of physiology in the Faculty of Medicine, University of Paris, on December 4, aged eighty-five years.

Sir Alfred Sharpe, K.C.M.G., C.B., formerly governor of Nyasaland, who was well known as a traveller and big-game hunter, author of "The Backbone of Africa" (1921), on December 10, aged eighty-two years.

Lieutenant-Colonel E. W. White, C.B.E., emeritus professor of psychological medicine in King's College, London, on November 28, aged eighty-four years.

News and Views

The Ultimate Value of Science

IN a recent address on "Ultimate Values of Science" before the Commonwealth Club of San Francisco, Dr. J. C. Merriam, president of the Carnegie Institution of Washington, discussed the question whether, by reason of science or research, the world has been made a better place in which to live, or life has become more worth while. Referring first to the way in which better use is being made through science of natural resources, Dr. Merriam pointed out that though we have still a long way to go in learning to control the living world, the way has been marked out, and mankind may be expected to follow it. Moreover, organisation of society has made possible the transmission of knowledge from one generation to another, and science in particular has made possible the recording and continuous development of knowledge in a way which no one generation could achieve alone. The whole capacity for constructive work has been increased, and science is gradually giving us a new outlook over the universe, with ampler opportunity for appreciation of life and a new attitude towards its problems. The scientific point of view and the humanistic point of view require adjustment, if the full value of science, art, philosophy and religion is to be secured for mankind.

DR. MERRIAM urged that science, by reducing the uncertainties of life, increasing the assurance of progress and broadening the possibilities of achievement, has increased the opportunity for constructive living and thus favoured the development of the individual. He insisted that the problem of leisure should be considered primarily in terms of opportunity, and that it is essential to guard against a narrow vision in facing this and other problems of citizenship. The direct facing of the issues, the honest use of all the knowledge gained, is the surest way to recovery, and the wide acceptance of an attitude of mind illustrated by the pattern of scientific thought with its persistent search for facts upon which to base judgment and its broad vision over the world of things and events is an urgent need. The building of a better world depends upon the quality of intelligence used and upon clarity of vision, as much as upon thorough investigation and correlation of the facts.

Romanticism and the Modern World

AT the Royal Institution on December 6, Mr. F. L. Lucas, fellow and librarian of King's College, Cambridge, delivered a discourse on this subject. Romanticism, he said, may perhaps be called the literature of intoxication and dream. Freud has pictured the human ego as living a harassed life between the conflicting claims of the instinctive, animal 'id', the 'super-ego' or sense of social obligation, and the 'reality-principle' or sense of fact. Eighteenth-century classicism shows above all a too tyrannical control, by the two last, of the dreams and impulses that rise from the less conscious depths of personality. The Romantic revival was a revolt of dreamers against those twin sleepless dragons—'good sense' and 'good taste'. Though the Romantic Empire declined and fell, at its heart remains an eternal city. Romance is not dead. The science of the nineteenth century seemed to expel her with a brandished test-tube; the science of the twentieth re-opens the door to her with a bow. Yet this should not be exaggerated. The recently expressed view that poetry is independent of truth, a mere alcohol to stimulate 'emotional attitudes', is in its turn

a mystical excess. The world about us grows, it is true, more and more a dance of phantom formulæ on the points of dial-needles—the very stuff of dreams. Yet there are dreams and dreams. Some cohere and work; others do not. Incoherence was the weakness in the romanticism of Shelley or Victor Hugo; it is the romanticism of Homer or Hardy that is more enduring. Though dreaming, they imposed order and consistency even on their fantasies. Classicism, realism, romanticism, are all extremes—the three points of a triangle within which lies inscribed the magic circle where walk the greatest masters.

Parliamentary Science Committee

AT the annual meeting of the Parliamentary Science Committee held at the House of Commons under the presidency of Sir Arnold Wilson on December 5, the following officers were elected: *President*, The Right Hon. the Earl of Dudley; *Chairman*, Sir Arnold Wilson, M.P.; *Vice-Chairman*, Prof. B. W. Holman; *Deputy-Chairman*, Mr. Alan E. L. Chorlton, M.P.; *Hon. Secretary and Treasurer*, Mr. H. W. J. Stone. The honorary secretary's annual report discloses that representative scientific and technical institutions continue to affiliate to the Committee. During the 1934–35 session, questions were asked in Parliament concerning agricultural and horticultural research, interchangeability of water supplies, the International Locust Conference, milk pasteurisation, aeronautical engines (output), the gas grid scheme, the possibility of constructing earthquake-proof buildings in India, the research powers of the agricultural marketing boards, technical education and grants for industrial and agricultural research. Members of the Committee took an active part in the debates on the Herring Industry Bill and the Metropolitan Water Board General Powers Bill. Looking to the future, the Committee contemplates consideration in the near future among other things of such widely diverse subjects as the endowment of research, the finance of industrial research, income tax exemption on industrial research, patent legislation reform and the remission of death duties on bequests for research. The Committee compiles from Hansard and other sources a monthly summary of all scientific and technical matters considered in Parliament. The third volume of "Science in Parliament" has just been completed, and issued with a cross-reference index. Owing to the coming demolition of the Adelphi, the Committee is moving to Granville House, Arundel Street, Strand, W.C.2, on January 1.

The Imperial Cancer Research Fund

AT a meeting of the General Committee of the Imperial Cancer Research Fund held on December 4, the Duke of Bedford presiding, the thirty-third annual report of the Fund, dated 1934–35, was presented. A tribute was paid to Dr. J. A. Murray, who retired on October 1 after holding the directorship of the Fund since 1915, and who is succeeded by Dr. W. E. Gye. Dr. Gye in his report surveyed the scientific activities of the Fund since its inception, and referred to the work now in progress. The bearing of the researches upon tar cancers of mammals, and of the malignant sarcoma of fowls, the virus of which is a filterable one, on problems of human cancer was discussed, and Prof. J. McIntosh's experiments upon tar cancers of the fowl were summarised. The last-named tumours can at first be transmitted only by transplantation of a portion of the growth, but after transmission by this method for a few generations, it appears possible to transmit them by means of cell-free filtrates, that is, the virus becomes a filterable one comparable to that of the fowl sarcoma. The honorary treasurer, Sir H. J. Waring, reported that the Fund had a surplus of £7,568 for the year, and that legacies, donations and subscriptions all showed an increase over 1934. At the same time, the work is expanding, and expenses are likely to increase in the future, and he, therefore, made an appeal for additional contributions to the Fund. Dr. Gye, in summarising the present position of cancer research, said: "So far from there being any justification for pessimism, laboratory workers can all feel hopeful that the rapid progress now being made will lead to the solution of the primary problems of cancer".

Minerals and their Utilisation

SIR THOMAS HOLLAND, principal and vice-chancellor of the University of Edinburgh, propounded some very pertinent questions in proposing the toast of the profession of chemistry at the Ramsay Chemical Dinner held in Glasgow on December 6. Sir Thomas said that some of the problems which have been baffling geologists for a long time are really problems for the chemist. In the early days, geologists were content with a knowledge of the principal constituents of minerals, and based their classifications on these. But it has become evident that, in some cases, it is the smaller constituents of a mineral which are the most important. With civilisation has grown the desire for the use of metals, and this desire has increased and will continue to increase until the supply of metals has been exhausted. What the geologist is most interested in and what he wants the help of the chemist to solve are, therefore, the laws which control natural deposits. These reactions of Nature have gone on for countless ages of time, and have produced local concentrations of minerals. We produce annually about 50,000 tons of nickel and 1,500,000 tons of copper, and yet the crust of the earth contains about twice as much nickel as copper. Our production of lead is about the same as that of copper, and the available supplies of lead are only one fifth of those of copper and therefore one tenth of those of nickel. Zinc, of which we produce more than 100,000 tons a year, is only half as abundant as copper, and we use three times as much tin as nickel, though the supplies of nickel are 50–100 times those of tin. There is surely something wrong in this relationship. The different habits of rocks in showing that varying tendency towards rearrangement of their constituents open up problems in physical chemistry which are still largely obscure.

Physics in Industry in the United States

THE Advisory Council on Applied Physics of the American Institute of Physics met at the University Club, Pittsburgh, Pa., on November 16. This was the inaugural meeting of this Council, the purpose of which is to stimulate the application of physics by recommending suitable actions and policies to the Institute and the founder societies. Dr. Paul D. Foote, executive vice-president of the Gulf Research and Development Corporation, presided during the morning session and Dr. Lyman J. Briggs, director of the Bureau of Standards, during the afternoon. A discussion was held on the university education and training of men whose careers are to lie in industrial research. This discussion was opened with reports by Dr. Saul Dushman (presented by Dr. A. W. Hull) of the General Electric Co. and Prof. George H. Harrison of the Massachusetts Institute of Technology. Further discussion was devoted to the services which are rendered by the founder societies and the Institute to physicists employed in industrial laboratories. Reports on this topic were presented by Dr. L. O. Grondahl, director of research, Union Switch and Signal Co., and Prof. John T. Tate, of the University of Minnesota. In this connexion, the Council passed a resolution encouraging the formation by such physicists of a division on applied physics of the Physical Society. It is strongly felt that, while the Optical Society, the Acoustical Society and the Society of Rheology furnish splendid facilities for meetings and publications in their fields, other general applications of physics are neglected. The opinion of the Council is opposed to the formation of new specialised societies, since only through close integration with the Physical Society can the community of interest and interchange of ideas between the general applications and the basic fundamentals of physics be conserved.

South Indian Bronzes at South Kensington

BRONZE figures of the members of the Hindu Pantheon in their various manifestations are a conspicuous feature in the art of southern India. Of these, there is a large collection in the Madras Government Museum, which is perhaps not so widely known in detail as it deserves. The iconographic value of these bronzes is great: they are an important source of information for Hindu religious and cosmological conceptions; but, as a rule, their artistic merit is not high. It is now announced that, by a bequest of the late Lord Ampthill, formerly Governor of the Madras Presidency, the Victoria and Albert Museum, South Kensington, has acquired five of these bronzes, which are both of high artistic merit and of interest for their religious significance. Of these the most important is a figure of Siva as the Cosmic Dancer, which expresses the idea that the god himself is both performer and audience, while the universe is his theatre. The figure is four-armed, and appears in a dancing attitude in an encircling flaming nimbus. In its upper hands are a drum and fire as the symbols of creation and destruction respectively, while the lower hands are in the conventional attitudes of protection and assurance. The headdress includes a crescent moon, a human skull, cobras and flowers. The male and female principles are signified by a man's ear-ring in the right ear and a woman's ear-ring in the left ear. With this figure is shown one of his consort Parvati, in the manifestation of Gauri. These figures were found buried near a temple in the Tinevally District of the Madras Presidency. They were made by the *cire perdue* process; and from their stylistic affinities it is concluded that they belong to the late tenth or early eleventh century of our era. Lord Ampthill's bequest, part of which had previously been on loan in the museum, includes, in addition to the five bronzes, a number of other objects of great interest, illustrative of Brahmanical and Buddhist beliefs.

Vision in Optical Instruments

IN his Thomas Young Oration of the Physical Society on December 6, Prof. Charles Fabry discussed "Vision in Optical Instruments". Classical theory gives the *resolving power* of an optical instrument as determined by diffraction phenomena, but the result so obtained takes no account of the properties of the eye. Consequently, it does not indicate exactly what will actually be perceived with an instrument. What can actually be seen with such an instrument depends considerably on the brightness of the object examined, and on the degree of contrast between its parts and between the object and the background. In order to examine these questions, it is necessary to commence with the properties of the eye, and in particular, its ability to distinguish objects, not under the ideal conditions reached in the laboratory, but under conditions similar to those met with during observations. The effect of brightness is particularly large: for the greatest brightness the limit of resolution is about 1′, whilst it is 250 times as large (about 4°) for barely perceptible brightness. Contrast also has a very large effect. With these data, it becomes possible to determine what the eye will really see in a given instrument, assumed to be of perfect geometrical construction. The optimum size of exit-pupil can be calculated, and is found to be 0·7 mm. for the highest illumination, in agreement with experience. For an instrument with geometrical imperfections, an efficiency can be defined characterising the qualities of this instrument as compared with those of a perfect instrument. Stray light (fog) is another cause of inferiority in instruments, and the effect of this factor was discussed by Prof. Fabry.

Automatic Fire and Burglar Alarms

A DEVICE, invented in France, which can be used either as a fire alarm which will give automatically a telephone message to the fire brigade, or as a burglar alarm which will summon the police, is described in *The Times* of December 7. The apparatus is called a 'signaphone', and is already installed in about forty buildings in Paris. When used as a fire alarm, the device is operated either by thermostats fixed near the ceiling, or by push buttons so that a watchman has only to press the nearest button. The thermostats are operated by hot air rising to the

ceiling when fire breaks out. This breaks a closed electric circuit, and an electrical relay at once starts a clockwork motor. The motor drives a small dialling drum, the small metal discs on which correspond to the letters and figures of the telephone number of the nearest fire station. The station is thus called up and a gramophone record then comes into action giving, in a verbal message, the location of the fire and all essential details. This message is repeated continuously for 3½ minutes. If necessary, also, it can be made to ring up a second number—for example, that of the owner of the building—and repeat its message. When used as a burglar alarm, the signaphone is connected with an electric circuit in the building. In this case, a burglar who opens a door or window, takes down a picture or tries to open a safe or desk, without knowing it thereby summons the police, who learn from the the gramophone message what is happening. Anyone who desires to have both a fire and burglar alarm must have two signaphones installed. The Post Office has given permission for these devices to be attached to telephones on automatic exchanges. It has also met with the approval of the Metropolitan Police, to whom it has been demonstrated.

Equalising Supply and Demand

IN the first number of *Trends—A Monthly Graphical Review of Business Movements* (H. Whitehead and Staff, 20 Buckingham Gate, S.W.1, October 1935), Mr. Harold Macmillan contributes an interesting article on "Equalising Supply and Demand" in which he emphasises the importance of planning an adjustment of productive effort, so as to ensure the production of all goods and services in the quantities which will enable them to exchange for one another at prices covering their production costs. The regulation of production in relation to demand for the products of each industry requires that some common policy should be pursued by all the units collectively, for example, in regard to scientific research, observance of standard wages and conditions, maintenance of standards of quality or standardisation of the range of patterns. But as things are, a common policy must depend on voluntary agreements, and in the great majority of cases voluntary agreements break down because, when they have created conditions of stability and profitability, other producers are attracted who can exploit the market by the old methods. Mr. Macmillan therefore urges that it is necessary to give industry legal powers to enforce upon a recalcitrant minority decisions which have been approved by a large majority of the producers and have been sanctioned by Parliament. It is essential, however, that there should be adequate safeguards to defend the general public interest and the special interests of consumers and workers affected in each case.

Despotic and Democratic Governments

THE question as to whether parliamentary democracy can survive its present crisis and whether the rise of dictatorships in Italy, Germany and Russia does not indicate the decline of a long epoch of parliamentary government, is discussed by Mr. Herbert W. Stewart in an article in the *Hibbert Journal* (April, 1935). Mr. Stewart definitely rejects the modern scepticism, although he is far from denying many of the difficulties and real dangers involved in the parliamentary system, such as party intrigues, the corruption of the free but corruptible Press, the demagogic misuse of public institutions under parliamentary control. The unavoidable dilemma of this system seems to be that current affairs are run either by expert commissions, more or less on account of the initiative of the electorate and its parliamentary representatives—or by the masses themselves, and this involves the danger of delicate political matters becoming dependent on the issue of demagogical party activities and political bargainings.

COMPARING these dangers with those of Fascist States, however, Mr. Stewart concludes that Fascist State policy is apt to replace a comparative evil by a much more radical one; for an oligarchy controlling the key positions of the State is worse than the personal power of local cliques under parliamentary government. Parliamentary corruption is the smaller evil as compared with the possible and hidden corruption under a despotic government. The disadvantages of democratic governments should not be over-stressed. In the United States, Canada and Great Britain, after all, the individual voter does not feel that the electoral victory of any one of the existing parties might jeopardise the country. Parliamentary institutions are capable of adapting themselves to new circumstances and of modifying themselves. In the long run, the masses do not wish to be without these means of self-expression.

Solar Activity and Radio Transmission

RECENTLY, Dr. J. H. Dellinger, head of the radio section of the Bureau of Standards at Washington, suggested that a close watch should be kept to see whether there was a fade-out of radio transmissions at any time between October 21 and 25. He was led to make this suggestion by the discovery of severe fading occurring on March 20, May 12, July 6 and August 30, which indicate a 54-day cycle. According to a report issued by Science Service, Washington, D.C., certain short wave-lengths were wiped out by eruptions of the sun for the single day October 24. This fade-out sheds new light on the difficult problem of the connexion between radio transmission, sunspots and magnetic storms. Ordinary transmissions having wave-lengths approximately the same as those used in domestic broadcasting were not affected; but experimental radio transmission was completely wiped out, and the sending of commercial and amateur radiograms was greatly hampered.

THE Bureau of Standards describes the occurrence on October 24 as a wiping out of radio transmission above a certain frequency. It is also stated that there was probably some eruption in the sun much more sudden than the growth of a sunspot, and that this abruptly changed the rate at which the sun

sent certain waves or particles into the earth's atmosphere. Previously there has been no way of identifying the magnetic disturbances associated with such eruptions. As the radio effects are easily identified, it is hoped to get a closer insight into the connexion between them and solar disturbances. In a later report by Prof. H. G. Gale of Mount Wilson Observatory, it is stated that on the morning of October 24 a group of dark granular flocculi was observed on the sun's disk. This group was observed frequently during the day, and at its maximum it was the largest object on the sun's surface as observed by the hydrogen spectroheliograph. The increased solar activity paralleled the strange radio fade-out. Technical details are given in the November 15 issue of the *Physical Review*.

Science and Vegetable Production

MR. F. A. SECRETT lectured before the Royal Society of Arts on November 27, the subject of the discourse being "Modern Methods of Vegetable Production and Marketing". Mr. Secrett, as the owner of Holly Lodge Farm, Walton-on-Thames, is well qualified to speak on this topic (see NATURE, May 25, p. 866). Mr. Secrett's outlook combines the enthusiasm of the amateur with business acumen and scientific discrimination. One of the problems of intensive culture is to obtain sufficient humus for the soil. Sewage waste and town refuse may possibly fill the need, but Mr. Secrett insisted that fresh or green manure has a denitrifying effect on the soil. The technique of irrigation by overhead sprays, and of heating the soil by hot water pipes laid in troughs of water below the soil, were described in detail, for Mr. Secrett is an authoritative exponent and pioneer in the application of these practices. Particular attention was given to methods of aerating the irrigation water, and of incorporating soluble fertilisers. The section on marketing dealt with the use of non-returnable packages, the reorganisation of commission sales, and the revision of railway rates. Much criticism of the work of marketing boards was given, and Mr. Secrett showed, by reasoned argument and without caustic remark, that the unvaried edict of bureaucratic control is often opposed to the best interests of a dynamic and changeable industry such as vegetable growing.

Mount Everest Expedition

IN preparation for the new Mount Everest expedition of 1936, a reconnaissance party was at work last year. At the Royal Geographical Society on December 2, Mr. E. E. Shipton gave an account of this expedition. The main objects were to investigate snow conditions at high altitudes and decide on the best season for the attempt on the summit, to examine the possibility of alternative routes either by the north-west ridge from the head of the Central Rongbuk glacier or by the unknown Western Cwm, and to test equipment. An exploration of the western approaches to Mount Everest revealed no possible way of approach to the summit. Moreover, it was found that the ice slopes of the North Col were in a very dangerous condition during the whole of the monsoon, and always liable to be swept by avalanches the occurrence of which it was impossible to foretell. The expedition scaled numerous hitherto unclimbed peaks in the district in the course of its work.

Housing and Overcrowding

THE Ministry of Health has recently issued several circulars dealing with the subjects of housing and overcrowding, all published by H.M. Stationery Office. "Housing" (2*d*. net) summarises the principal provisions of the Housing and Public Health Acts in relation to maintenance of dwellings in a reasonably fit condition. "Housing, England" (Statutory Rules and Orders 1935 No. 1115. 1*d*. net) relates to the appointment of a committee, to be called the Central Housing Advisory Committee, for the purpose of advising the Minister on questions relating to overcrowding. "Circular 1507" deals with Section 1, Housing Act, 1935, and fixes dates for (1) the completion of inspection—April 1, 1936, (2) submission of report—June 1, 1936, and (3) submission of proposals—August 1, 1936. "Statutory Rules and Orders 1935 No. 1086" (3*d*. net) makes regulations applying to polls of local government electors in connexion with the promotion of bills by councils other than councils of metropolitan boroughs. The Central Housing Advisory Committee appointed by Sir Kingsley Wood includes among other prominent members the names of Lord Balfour of Burleigh, the Earl of Crawford and Balcarres and the Earl of Dudley, the Bishop of Winchester, Miss Megan Lloyd George, Sir Francis Fremantle, Dr. Greenwood Wilson and Mr. Silkin.

A Long Barrow in East Anglia

IT has been supposed that no long barrows exist in Norfolk and Suffolk, and various theories have been put forward to account for the absence of the long-barrow culture in these counties. Some have supposed that it never existed in these areas, while others have thought that the non-existence of the burial mounds is to be accounted for by their removal through ploughing or other agricultural operations. It now seems that the latter is the more likely explanation as, recently, Mr. J. E. Sainty, of The Hedges, West Runton, near Cromer, and his friend Mr. A. Q. Watson, of Holt, have discovered, in west Norfolk, what has every appearance of being a long barrow, surrounded by a ditch. This is a noteworthy find and the discoverers hope to be able to excavate the site in the near future.

Science in the Public Press

WE are glad to direct attention to a series of eight articles on scientific problems of particular human interest now being contributed to the *Evening Standard* by competent authorities on the subjects with which they deal. The first article, by Prof. H. Levy, in the issue of December 9, presents a philosophic picture of the universe. Succeeding articles in the series are "What is Death?", Prof. J. B. S.

Haldane; "Is There an After-life?", the Bishop of Birmingham; "Can We Create Life?", Prof. F. G. Donnan; "Is There Life on the Planets?", Dr. H. Spencer Jones; "Why Do I Dream?", Prof. Cyril Burt; "Can We Harness the Atom?", Prof. E. N. da C. Andrade; and "What Is My Conscience?", Prof. J. C. Flügel.

New Research Laboratory of the L.M.S.

ON December 10, Lord Rutherford opened the new L.M.S. Railway research laboratory at Derby in the presence of many well-known scientific workers and industrialists. Before the special train left St. Pancras, Pat Rutherford, grandson of Lord Rutherford, had the honour of naming the new Crewe-built engine of the special train. Sir Josiah Stamp first introduced him to the leading guests and then lifted him on to the running-plate of the engine. A purple cloth covered the name-plate. Pat pulled the cord to unveil the plate and called out, "I name this engine 'Lord Rutherford of Nelson'". We propose to print an account of the speeches made at the opening of the new laboratory at Derby in our next issue.

The 200-inch Disk for the Mount Wilson Observatory

ACCORDING to the New York correspondent of *The Times*, the second two hundred inch pyrex glass disk which has been made at the Corning Works for the California Institute of Technology has been accepted as satisfactory by the scientific representatives of that institution. The disk has been annealing for twelve months, and it is expected that the process of grinding and figuring, which will take place at Pasadena, Cal., will occupy five years. There are said to be some flaws on the surface of the disk: these were caused through the floods of this summer, which shut off the heating apparatus for forty-eight hours, but they will be removed during the grinding process. Astronomers and others on the east of the Atlantic who have followed the not uneventful history of the manufacture of the mirror for the two hundred inch telescope with great interest, will be glad to hear that the present disk is satisfactory, and will wish their American colleagues a little luck, of which perhaps they have not yet had their share, in their delicate and long-continued operations on this large disk.

Announcements

THE honorary membership of the Royal Asiatic Society has been conferred upon Prof. Wilhelm Geiger, of the University of Munich, in recognition of his eminent services to Indian and Iranian philology.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. J. C. Cater, to be assistant conservator of forests, Trinidad; Mr. H. E. C. Lewys-Lloyd, stock inspector, Tanganyika, to be assistant live stock officer, Uganda.

DR. WILBUR A. SAWYER has been appointed director of the Division of International Health of the Rockefeller Institute, New York.

THE fourth International Congress of Cytology will be held in Copenhagen in 1936. The exact date has not yet been fixed, but the Congress will probably take place in August. Further information can be obtained from the General Secretary, Nassaustrasse 17, Berlin-Wilmersdorf.

THE Iron and Steel Institute is offering a number of grants from the research fund founded by Mr. Andrew Carnegie in aid of metallurgical research. Candidates for grants must be less than thirty-five years of age. Applications should be made before January 10 to the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

THE first International Congress of Criminal Anthropology and Psychiatry will be held in Rome next April, when the following subjects will be discussed: etiology, diagnosis and prognosis of criminality in minors; prophylaxis of crime in relation to penal laws; fundamental conception of criminal biology; and prophylaxis of crime and criminal anthropology. Visits will be paid to the various Italian institutions for the prevention of criminality and re-education of delinquents in Rome, Naples, Orvieto and elsewhere. Further information can be obtained from the general secretary, Prof. B. di Tullio, via Giulia 52, Rome.

A PRACTICAL brochure entitled "Instructions for Collectors: No. 4—Insects", published by the British Museum (Natural History), has recently appeared in its eighth edition. It gives instructions, intended chiefly for persons travelling abroad, as regards the best methods for collecting insects and the essential apparatus. It is obtainable from the Museum or through booksellers, price 3*d*. (postage 1*d*).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A part-time lecturer in practical mathematics in East Ham Technical College—The Secretary for Education Town Hall, East Ham, E.6 (Dec. 17).

A scientific officer at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Dec. 19).

An assistant instructor in dairying to the Wilts County Council—The Clerk of the Council, County Offices, Trowbridge (Dec. 19).

Pharmacist-inspectors to the Pharmaceutical Society of Great Britain—The Secretary of the Society, 17 Bloomsbury Square, W.C.1 (Jan. 1).

A professor of mathematical physics in the Indian Institute of Science, Bangalore—The Director (Jan. 15).

A professor of physiology in the University of Queensland—The Secretary, Universities Bureau, 88A Gower Street, W.C.1 (Jan. 25).

An assistant lecturer in mathematical physics in University College, Hull—The Registrar.

An assistant lecturer in chemistry in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 956.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Chemical Detection of Artificial Transmutation of Elements

IT has been our aim for years to prove the result of transmutation experiments by chemical analysis, and in a brief report[1] we have described our failure to find chemical evidence for the production of hydrogen or neon by bombardment with α-rays. In the meantime, many new ways of artificial transmutation have been found, and the discovery of artificial radioelements has enabled Curie and Joliot[2] to use the methods of radio-chemistry, that is, the combination of radioactive measurement with chemical operations, for the investigation of the chemical character of products of artificial transmutation. This line of work has been extended by Fermi and his collaborators and by many others. The quantity of newly formed matter has in general been much too small for any attempt at a purely chemical detection; the claim[3] of having separated and spectroscopically observed helium of atomic weight 3, made from heavy hydrogen, has been disproved by later work[4].

At present, for various experimental reasons, the best choice for the chemical detection of an artificially-produced element seemed to be helium originating from boron according to the reaction[5]

$$_5B^{10} + {}_0n^1 = {}_3Li^7 + {}_2He^4.$$

In a closed copper vessel we bombarded the methyl ester of boron with neutrons. These were produced near the centre of the spherical vessel by the decay of radon, mixed with beryllium, and were slowed down by the hydrogen atoms of the ester and of the water surrounding the metal flask. In a first experiment, by the decay of 450 mC. of radon, sufficient helium was produced for a spectroscopic observation. During a second experiment, lasting seven weeks, we procured enough radon to allow 2,200 mC. of it to decay in our apparatus. This time we were able not only to observe spectroscopically the helium produced but also to measure it; we found, to an accuracy of about 20 per cent, $1 \cdot 3 \times 10^{-7}$ c.c. helium. A blank test run afterwards for nine weeks under exactly the same conditions, but without radon-beryllium tubes, showed not the slightest sign of helium production.

The copper vessel was a sphere of only 7·5 cm. radius; it is unlikely that more than half of the neutrons formed in the beryllium tubes were caught by the boron inside the vessel. A new experiment, making use of a larger flask, is in progress; but it can already be concluded from our preliminary figures (as one helium atom, according to the above equation, needs for its production one neutron) that a millicurie of radon, mixed with beryllium, produces more than 3,000 neutrons a second[6].

In this experiment—for the first time, so far as we are aware—an artificially produced element has been separated, spectroscopically observed, and measured. We presume that the old alchemistical goal can be achieved to-day in other cases also.

We wish to express our sincere thanks to Prof. F. L. Hopwood, director of the Radium Department, St. Bartholomew's Hospital, London, to Prof. S. Russ, director of the Radium Department, Middlesex Hospital, London, and to Prof. Stefan Meyer, director of the Institute for Radium Research in Vienna, for kindly supplying the radon-beryllium tubes; and also to Dr. E. Glückauf for assistance in the experiments.

F. A. PANETH.
H. LOLEIT.

Imperial College of Science
and Technology,
London, S.W.7.
Nov. 28.

[1] F. A. Paneth and P. L. Gunther, NATURE, 131, 652; 1933. See also *Z. phys. Chem.*, *A*, 173, 401; 1935.
[2] I. Curie and F. Joliot, *C.R.*, 198, 559; 1934.
[3] G. P. Harnwell, H. D. Smyth and W. D. Urry, *Phys. Rev.*, 46, 437; 1934.
[4] H. D. Smyth, G. P. Bleakney and W. W. Lozier, *Phys. Rev.*, 47, 800; 1935. F. A. Paneth and G. P. Thomson, NATURE, 136, 334; 1935.
[5] J. Chadwick and M. Goldhaber, NATURE, 135, 65; 1935. *Proc. Cam. Phil. Soc.*, 31, 612; 1935. H. J. Taylor and M. Goldhaber, NATURE, 135, 341; 1935. E. Amaldi, O. D'Agostino, E. Fermi, B. Pontecorvo, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, A, 149, 522; 1935.
[6] The ordinarily assumed yield of neutrons under these conditions is 1,000 neutrons per sec. (See, for example, E. Fermi and collaborators, *Proc. Roy. Soc.*, A, 146, 483, 1934.) According to R. Jaeckel's observations (*Z. Phys*, 91, 493; 1934) the value 10,000 neutrons per sec. is more likely.

Absorption of Residual Neutrons

AMALDI, D'Agostino, Fermi, Pontecorvo, Rasetti and Segrè have discovered that certain elements strongly absorb neutrons which have been slowed down by paraffin wax[1]. They report, for example, that thin sheets of cadmium or indium of 0·013 gm./cm.^{2} and 0·3 gm./cm.^{2} thickness respectively cut down the intensity of a beam of slow neutrons to half its value and find for iodine a half-value thickness of 4 gm./cm.^{2}.

Thick sheets of a strongly absorbing element, such as cadmium, will, however, still transmit an appreciable fraction of the incident heterogeneous beam, and in these circumstances it appeared to be of interest to investigate the absorption of such residual neutrons in some elements.

In one set of experiments, I filtered slow neutrons by a sheet of cadmium, 1·6 mm. (1·4 gm./cm.^{2}) thick, and determined the absorption of the residual neutrons in several elements, using radioactivity induced in indium (54 min. period) as an indicator of the neutron intensity. The residual neutrons from the thick cadmium filter are scarcely absorbed by cadmium itself—a 0·5 mm. thick cadmium absorber will absorb perhaps less than 10 per cent of the residual neutrons. Yet I find that these residual neutrons are strongly absorbed by some elements—for example, a thin indium absorber of less than

0·3 gm./cm.^{2} (0·4 mm.) thickness absorbs more than two thirds of the intensity.

Cadmium absorbs the bulk of the unfiltered beam much more strongly than indium, but as we see, it is transparent for some component of the unfiltered beam which in its turn is strongly absorbed by indium. This fact is in contradiction to the current conclusions drawn from the theory of radiative capture.

Fermi *et al.*, Bethe, Perrin and Elsasser attempted to explain the observed large absorbing cross-sections of elements such as cadmium without assuming long-range forces of the nucleus. They have assumed that the range of these forces is small compared with the wave-length λ of the slow neutron and that the neutron is captured in a deep energy level of the nucleus, the excess energy of several million volts being carried away by an emitted photon. They have demonstrated that large effective absorbing cross-sections result if resonance occurs, and it can be shown that the degree of this resonance will not change appreciably with the neutron energy between thermal energies and some 10,000 electron volts. Consequently, if an element has an absorbing cross-section larger than another element for one particular neutron energy, it should not have a smaller absorbing cross-section for any other energy within this energy range.

The present observation on indium contradicts this conclusion. It cannot be argued in defence of the theory that the observed effect might be due to neutrons of energies higher than some 10,000 volts, since the observed very large absorbing cross-section of the indium atom for the residual neutrons would then have to exceed λ^2/π—the limit set by the theory.

In our experiments, use was made of the fact that slow neutrons will diffuse through a paraffin wax tube in much the same way as a gas will diffuse through a tube, if the mean free path in the gas is large compared with the diameter of the tube. The neutrons were led from a radon-beryllium source of about 200 mC. through a paraffin wax tube of 13 cm. inner diameter and 20–40 cm. in length to filter, absorber and indicator sheets and passed only once through these sheets.

Control experiments show that the observed absorption is not due to reflection (back scattering) from the indium absorber. Reversal of the position of cadmium filter and indium absorber produces no change in the transmitted intensity, and this fact indicates that the observed highly absorbable residual neutrons are not produced in our cadmium filter but form part of the unfiltered beam. We are thus led to the conclusion that we have to deal in these experiments with types of absorption spectra for which the present form of the theory cannot account.

There were earlier observations[2], especially those reported some time ago by Moon and Tillman, which did not seem to fit in with the theory. Tillman and Moon showed that the absorption of slow neutrons in an element appears to be different if different elements are used as indicators, and that it often appears to be comparatively high, if the same element is used as absorber and indicator.

In the present experiments, the residual neutrons from cadmium show such selective absorption effects with some combinations of indium, silver and iodine, and show them much more markedly than the unfiltered beam. Moreover, some elements show, if one and the same element is used as absorber and indicator, a larger absorption for the residual neutrons than for the unfiltered neutrons; for example, less than 1 gm./cm.^{2} of iodine absorbs more than half of the residual neutrons if iodine is used as indicator. It would therefore seem that some elements have fairly sharp regions of strong absorption in an energy region for which cadmium is transparent.

It would be interesting to know the energy values which correspond to these absorbing regions. An attempt is now being made to determine them by studying the absorption in boron and lithium of the 'highly absorbable' components of the residual beam.

The observed strong absorption of residual neutrons makes it possible to construct efficient slits or shutters for the purpose of stopping out a well defined beam.

LEO SZILARD.

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Nov. 19.

[1] *Proc Roy Soc*, A, **149**, 522, 1935.
[2] Artsimovitch, T Kourtschatov, Miecowski and Palibin, *C.R.*, **200**, 2159; 1935. Bjerge and Westcott, *Proc. Roy. Soc.*, A, **150**, 709; 1935. Amaldi, D'Agostino, Fermi, Pontecorvo and Segrè, *Ric. Sci*, (vi), 1, No. 11–12. Moon and Tillman, NATURE, **135**, 904; 1935. Tillman and Moon, NATURE, **136**, 66, July 13, 1935 Ridenour and Yost, *Phys. Rev.*, **48**, 383; 1935.

The Slowing Down of Neutrons by Collisions with Protons

FERMI and others[1] showed that neutrons, passing through substances containing hydrogen, loose their energy by collisions with protons. It is of interest to discuss this process of slowing down somewhat further. So long as the energy of the neutron is higher than the energy with which the protons are bound in the molecules of the substance through which the neutrons pass, it seems evident that the latter give, on the average, half their energy to the proton at every collision. But when the neutrons are slowed down below this binding energy, they must excite rotation and oscillation of the hydrogen atom in the molecule in order to lose energy.

It is not certain whether the cross-section of protons for neutrons is a uniform function of the velocity of the neutrons, or if it shows discontinuities for energies comparable with the molecular bindings. In the latter case, it is possible that two substances, containing hydrogen held by different linkages, would show differences in slowing down the neutrons. We have carried out some experiments which indicate the existence of such differences.

Spheres with different radii (5–15 cm.) were alternately filled with water (0·11 gm. H/cm.^{3}), ethyl alcohol (0·10 gm. H/cm.^{3}), benzene (0·067 gm. H/cm.^{3}) and a liquid paraffin (0·14 gm. H/cm.^{3}). In the centre of the sphere a neutron source (radon+beryllium) was placed. The activation of a silver plate, which was fixed on the surface of the spheres and exposed for five minutes to irradiation, served as a measure of the intensity of slow neutrons.

Fig. 1 shows the number of slow neutrons per unit of the solid angle plotted against $r\,d$, where r is the radius of the sphere and d the quantity of hydrogen contained by 1 cm.^{3} of the liquid in question. The general aspect of these curves is already known. For small radii a rapid increase of the intensity with increasing radius is observed, due to the slowing down of neutrons by collisions with protons. After a certain point, an increase of the radius causes a reduction of the intensity. This clearly shows that not all neutrons which pass the surface of a sphere are reaching the next bigger sphere. The vanishing of slow neutrons must be ascribed to absorption.

The absorption of slow neutrons by paraffin and other substances containing hydrogen has been studied in detail by Bjerge and Westcott[2], who found that the number of slow neutrons is reduced to a half after diffusion through 1·6 cm. of water. By a different method we obtained the value of 2·5 cm. for paraffin in a preliminary experiment. A source of neutrons was placed in the centre of a paraffin wax cube of 14 cm. side. Five plates of paraffin wax, each 1 cm. thick, and finally a small silver plate were placed upon this cube. A screen of cadmium was interposed between the paraffin plates at different distances from the silver plate. The activity of the silver, obtained for equal times of irradiation, increased when the distance between the silver and the cadmium was increased. A curve was obtained which showed that influence of the absorption of the cadmium decreased to a half when the distance between the silver plate and the absorber was increased by 2·5 cm.

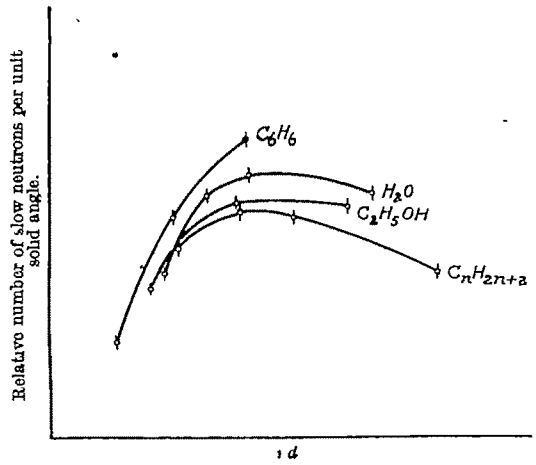

FIG. 1.

Fig. 1 shows that the maximum values of intensity are different for different liquids; these differences cannot be ascribed to the quantities of hydrogen contained by the liquids alone. Also, it is not possible to explain these results by absorption of slow neutrons by oxygen or carbon nuclei. A neutron has, for the same number of collisions with protons, passed twice the number of carbon atoms in benzene as in the liquid paraffin, and we see that the maximum value for the latter is much lower than for benzene, where the maximum seems to be just reached with the biggest sphere.

The differences in the influence of the four liquids examined, on the intensity of slow neutrons, cannot be ascribed to differences in the quantities of hydrogen, carbon or oxygen these liquids contain. Other differences between these liquids depend upon their molecular structure. Thus different probabilities for the slowing down of neutrons by excitation of rotation and oscillation of the hydrogen atoms in the different molecules may account for the discrepancies observed.

HANS VON HALBAN, JR.
PETER PREISWERK.

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Paris.
Nov. 5.

[1] Fermi and others, *La Ricerca scientifica*, (v) 2, 1; 1934. (vi) 1, 1; 1935.
[2] T. Bjerge and C. H. Westcott, *Proc. Roy. Soc.*, A, 150, 709; 1935

Quantised Field Theory and the Mass of the Proton

THE new theory of the electromagnetic field which I have proposed[1] seemed to allow an interpretation of the spin of the electron as a real electromagnetic angular momentum. Prof. W. Pauli was so kind to direct my attention to the fact that the quantisation of the field equations determines the total electromagnetic angular momentum as an integral multiple of $\hbar$; hence this interpretation is impossible.

My collaborator, Mr. M. H. L. Pryce[2], has, therefore, proposed a modification of the quantised field theory, in which there is ascribed to each singularity a spin, represented by non-commuting matrices of the Dirac type. Pryce remarked that this assumption may explain the existence of two different kinds of charged particles, electrons and protons, both with the spin $\frac{1}{2}$. For the electromagnetic angular momentum can have the values $j = 0, 1, 2, \ldots$ (in units $\hbar$). As the spin with the momentum $s = \frac{1}{2}$ may be parallel or anti-parallel to the electromagnetic moment, its component in this direction being $\sigma = +\frac{1}{2}$ or $\sigma = -\frac{1}{2}$, there exist two states with the total momentum $\frac{1}{2}$, namely, $j = 0$, $\sigma = \frac{1}{2}$, and $j = 1$, $\sigma = -\frac{1}{2}$. Pryce suggested that the latter state might have a much higher energy than the first one.

This conjecture of Pryce is strongly confirmed by an estimate of the relation of the energies or masses. The necessary formulæ have already been given by Schrodinger and myself in a note in NATURE[3]. There we started from the assumption (which I now consider as wrong) that the spin is the electromagnetic momentum; then the principal part of the energy of the electron would not be electrostatic but electromagnetic, and we showed that this would make the radius of the electron about 10 times larger than is usually assumed. Now I apply the same method for an estimate of the mass of the proton.

I assume that the chief part of the energy of the state $j = 1$, $\sigma = -\frac{1}{2}$ is electromagnetic and can be represented by $\frac{1}{2}\mu^2/r_0^3$, where $r_0 = e^2/mc^2$ is the conventional radius of the electron and $\mu = er_0/2\alpha$ the Bohr magneton ($\alpha = e^2/\hbar c = 1/137$).

Putting $Mc^2 = \mu^2/2r_0^3$, one gets by introducing the value of μ:

$$M = \frac{e^2}{r_0c^2} \times \frac{1}{8\alpha^2}.$$

In the non-rotating state $j = 0$, $s = \frac{1}{2}$, one has

$$m = \frac{e^2}{r_0c^2}.$$

Therefore

$$\frac{M}{m} = \frac{1}{8\alpha^2} = \frac{18{,}770}{8} = 2{,}400,$$

in sufficient agreement with the experimental value 1,840.

The use of the Bohr magneton μ for calculating the energy does not imply the assumption that the total magnetic moment is μ, which would contradict the facts. The spin contributes to the magnetic moment just a Bohr magneton of the opposite direction, and the resultant ought to be zero if the compensation were complete. It seems not surprising that there is a non-compensating part of the order $\mu/1{,}000$, as the experiments show.

If it is true that a proton and a positron (or a negative proton and an electron) are different states of the same system, there should be transitions from one to the other, for example, a transformation of a

proton into a positron under emission of light quanta of the order of magnitude $Mc^2 \sim 2{,}000\ mc^2$ or 1,000 millions of electron volts, as are actually found in cosmic rays.

MAX BORN.

Indian Institute of Science,
Bangalore.

[1] M. Born, NATURE, 132, 282; 1933. *Proc. Roy. Soc.*, A, 143, 410; 1934.
M. Born and L. Infeld, *Proc. Roy. Soc.*, A, 144, 425; 1934. A, 147, 522; 1934. A, 150, 141; 1935.
[2] Pryce's paper has not appeared yet. As we are now widely separated, he in America, I in India, I publish this confirmation of his idea without asking his consent.
[3] M. Born and E. Schrodinger, NATURE, 135, 342; 1935.

Frequency of Collision of Electrons in the Ionosphere

MESSRS. FARMER and Ratcliffe[1] criticise my results on this subject[2] on the ground that I have neglected the effect of a possible variation of the E layer attenuation during the three-quarters of an hour or so in which the observations were taken. Such a variation of E layer attenuation would involve a spurious contribution to the slope of the log ρ, P' curve, which would invalidate the calculation of the collision frequency. But where the reflection coefficient ρ decreases to a minimum and rises again (as in all cases observed), there are two branches to the log ρ, P' curve, one corresponding to ρ decreasing and the other to ρ increasing, and the effect of a continuous variation of E layer attenuation would be to increase the slope of one branch and decrease that of the other by the same amount. The effect of the variation of E layer attenuation is therefore automatically eliminated in taking the mean of the slopes of the two branches.

In actual results obtained where both branches are clearly defined, there is no significant difference between the slopes of the two branches (so far as the accuracy of the observation allows) so that the effect of the variation of E layer attenuation is certainly small.

Prof. Appleton's criticisms[3] are more fundamental, for he considers the formula from which the collision frequency is derived to be unjustified. My formula $\log \rho = \frac{-\nu_c}{2c} P'$ is contrasted with the more accurate formula $\log \rho = \frac{-\nu_c}{2c}(P'-P)$, and Prof. Appleton considers that the neglect of P may introduce considerable error, especially when P is of the same order of magnitude as P'.

It should be noted, however, that in the application to the determination of ν_c by my method, I am not so much concerned with the total reflection coefficient or equivalent path P', as with the changes $\delta \log \rho$ and $\delta P'$ occasioned by alterations in the layer as the maximum critical frequency ν_m approaches the frequency ν of transmission. As ν_m approaches ν, P' rapidly increases, if not to an infinite value at least to a very large value, while P tends to a definite limit. It follows that in the limit, as the critical frequency is approached, $\delta P'$ tends to a large value compared with δP, and the relation $\delta \log \rho = \frac{-\nu_c}{2c}\delta P'$ is accurately satisfied for the ordinary ray, while $\delta \log \rho = \frac{-\nu_c}{2c}\frac{\delta P'}{1-\tau/2}$ for the extraordinary ray. Thus the slope of the log ρ, P' curve gives ν_c quite accurately.

In order to test the accuracy of this relation, some examples have been worked out in which no approximation is made other than that involved in the assumption that $\alpha = \frac{\nu_c}{\beta\pi\nu}$ is small. The attenuation and group time derived from the real and imaginary parts of the refractive index were integrated by quadratures, and the relation between log ρ and P' was determined. The distributions of electronic concentrations in the layer considered were those which start from zero, reach a maximum at a height z_0, and then decrease. A typical example is shown in Fig. 1, in which $\log \rho \Big/ \frac{2\tau\alpha z_0}{\lambda}$ is plotted against $\frac{P'}{2z_0}$. In accordance with relation (1) the curve should, for large values of P', tend to a straight line the slope of which is unity for the ordinary ray and $1/(1-\tau/2)$ for the extraordinary ray.

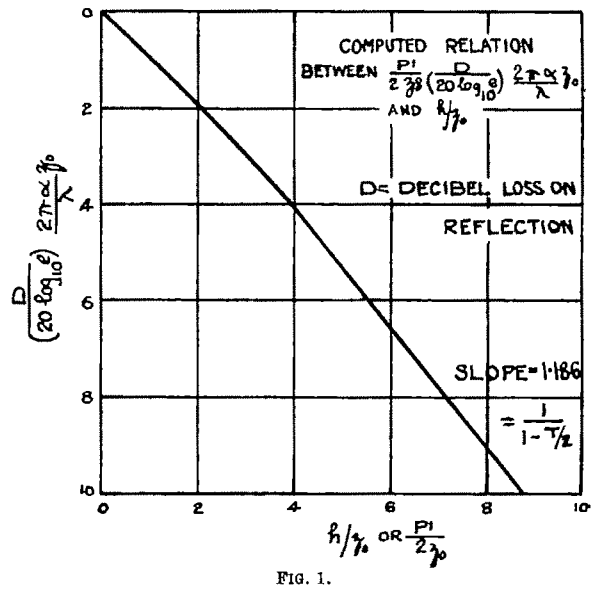

FIG. 1.

This is actually the case for the curve, which is calculated for the extraordinary ray with $\tau^2 = 0{\cdot}1$. The slope of the curve is constant for values of $P'/2z_0 > 4$ and agrees with $1/(1-\tau/2) = 1{\cdot}187$ within the errors of the graphical representation.

This general theoretical reasoning, backed by numerical examples, demonstrates clearly that the method given is quite accurate for the purpose of determining the collision frequency.

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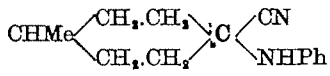
[1] NATURE, 135, 585; 1935.
[2] NATURE, 135, 435; 1935.
[3] NATURE, 135, 618; 1935.

Multiplanar Cyclohexane Rings

THE claim of Dr. Qudrat-i-Khuda[1] to the isolation of the four stereoisomeric forms of 1-carboxy-4-methyl*cyclo*hexane-1-acetic acid required by the Sasche-Mohr hypothesis which it has not been possible to substantiate in this laboratory[2] led us to search for further possible examples of this

phenomenon in reactions involving the methyl*cyclo*hexanones. Attention was directed, therefore, to the condensation of the cyanhydrins of methyl*cyclo*hexanones with arylamines, by an extension of the method used by Walther and Hubner in the case of the simple *cyclo*hexanone[3].

If, for example, 4-methyl*cyclo*hexanone were to react with potassium cyanide and aniline in the stabilised strainless forms, the production of four isomeric 1-cyano-1-anilino-4-methyl*cyclo*hexanes



would be anticipated. This reaction was actually studied by Betts and Plant some years ago, from quite another point of view[4]. Fractional crystallisation of the condensation product led, however, to the isolation of a more easily fusible isomer in addition to the 1-cyano-1-anilino-4-methyl*cyclo*hexane described by these authors.

The condensation of 4-methyl*cyclo*hexanone with *p*-bromoaniline, *o*-, *m*-, and *p*-toluidines, and the α- and β-naphthylamines led, with the exception of the case of *o*-toluidine, to the formation of pairs of isomeric cyanoarylaminomethyl*cyclo*hexanes. 3-Methyl*cyclo*hexanone behaved similarly towards aniline and gave rise to two isomeric forms of 1-cyano-1-anilino-3-methyl*cyclo*hexane, but with *o*- and *p*-toluidines and with the naphthylamines, the presence of only one individual could be detected. The cyanhydrin of 2-methyl*cyclo*hexanone also gave rise to pairs of isomerides on condensation with aniline and with β-naphthylamine. In the reactions with *o*-, *m*- and *p*-toluidines, and with α-naphthylamine, however, only one product was isolated.

In all the three methyl*cyclo*hexanones, therefore, the formation of two, but of never more than two, isomeric cyanoarylaminomethyl*cyclo*hexanes was observed in certain cases. A full report of these experiments will be published elsewhere.

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[1] NATURE, 136, 301; August 24, 1935.
[2] NATURE, 136, 608; October 12, 1935.
[3] *J. prakt. Chem.*, 93, 124; 1916.
[4] *J. Chem. Soc.*, 2073; 1928.

Breeding in Captivity of the South American Lung-fish

IN view of the advantages of the South American lung-fish, *Lepidosiren paradoxa*, as a laboratory animal on account of the large size of its cells and of its vitality, the first record, so far as I am aware, of a successful attempt to breed the fish is of general interest.

At the suggestion of Professor Graham Kerr, a double tank was installed in this Department in 1929, having a wooden lining fitted to float in a large outer tank of galvanised iron. The latter, erected over gas burners, serves as a water-jacket by means of which the temperature of the water in the inner wooden tank is maintained at 20° C. The inner tank, 9 ft. × 2 ft. 9 in. × 4 ft. 3 in., contains water to the depth of 1 ft. 8 in., and in addition about 30 cwt. of mud which was collected from a nearby loch. The mud is piled on an inclined plane diminishing in depth from 2 ft. 6 in. to 1 ft. It forms a narrow platform above the water-level on which an extensive growth of ferns has developed in the last eight months, and the water-surface itself supports a carpet of *Salvinia*. The temperature of the mud increases with depth, reaching a maximum of 26° C. at the bottom of the tank.

An adult female *Lepidosiren* has lived in this tank for the past six years. Until the spring of this year, she had as partner a male specimen which showed breeding signs from time to time; for example, enlargement of the filaments on the posterior appendages, burrowing and taking down vegetation to support the burrow walls. Young, however, were not forthcoming. This male died and was replaced in August by another adult which had lived in a separate tank in the Department for several years. Disturbance of the fish was reduced to a minimum. Maintenance of the water-level by means of two large shower sprays permanently mounted over the tank and connected to the main water supply was permitted, and also the regular introduction of food in the form of sliced beef every second day. No other disturbances were allowed and breeding must have begun very soon after the second male had been placed in the tank. On October 21–22, twenty-two post-larval young (that is, older than stage 36[1]) appeared at the surface amongst the *Salvinia* and were collected.

The *p*H of the water is 6·6 and the oxygen content at the surface 2·3 c.c. per litre, diminishing to 2·0 c.c. per litre at the bottom of the tank.

I am indebted to Mr. H. H. Brown for the oxygen estimations.

C. W. PARSONS.

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[1] J. Graham Kerr, "Normal Plates of the Development of *Lepidosiren paradoxa* and *Protopterus annectens*". Keibel's "Normentafeln zur Entwicklungsgeschichte der Wirbeltiere", 10; 1909.

The Species Problem

MAY I add a few words as a contribution to the species concept discussion which was touched upon in a recent article[1] in NATURE? The ideal species definition has not yet been given, and probably never will be given, the problem being of too complex a nature to be condensed into a single definition.

There is, however, one aspect of the theoretical problem, which I discussed some years ago[2], to which I wish to direct attention here, as I think that special point has not been sufficiently emphasised. Accepting the evolution theory, as we do to-day, we have definitely precluded the possibility of treating the species as the basal unit of taxonomy. The unit must be the different *lines of evolution*. I defined a line of evolution thus: "A taxonomical-phylogenetic line of evolution is a sequence of generations, the individuals of which descend from the individuals of the preceding generation and within each generation group themselves according to the law of probability with regard to all essential features, and further, form a closed sphere of combinations, reacting avitally or incompatibly with all other spheres of combinations with which it comes into contact". The species is the momentary realisation of such a line.

The great advantage of this view is that all demands for *constancy* are omitted from the species definition,

where they are, in reality, absolutely antagonistic to the theory of evolution. By regarding the species as an expression of the line of evolution, and only in that way, can we keep our species concept in conformity with the demands of the theory of evolution.

The curve of variation according to which the values of characters group themselves may change, but so long as it remains *one curve*, we really have the same species, as it is the realisation of the same line of evolution, even if the characters have changed. But if two (or more) different populations of a species change in different ways, so that the curves of variation are no longer congruent, two (or more) species arise from the old one. The line of evolution has divided into new ones, which manifest themselves as different species, none of which is identical with the old one, even if one of them might show to a certain extent the same exterior qualities. For the further consequences of my view I may refer to the original paper; I may add that the problem has recently been touched upon by Hiitonen[3].

KNUT FÆGRI.

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[1] NATURE, 136, 574, Oct. 12, 1935.
[2] Bergens Museums Årbok 1931. Natv. r. Nr. 4.
[3] *Mem. Soc. Faun. and Flor. Fenn.* (1933–34), 59; 1935.

"The University of London Council for Psychical Investigation"

IN September last the "University of London Council for Psychical Investigation" issued an invitation to an exhibition of fire-walking. Much attention was given to the subject in the daily Press, and an account of the demonstration was contributed by Mr. C. R. Darling to NATURE of September 28, p. 521. From the reports it is not clear what 'psychical investigation' had to do with the heat-resisting properties of the soles (? souls) of the feet; but what was more important was the interest apparently taken by the University of London in an unusual method of studying thermal conductivity. On inquiring, indeed, of the Principal, I was told that the 'University of London Council for Psychical Investigation' had no connexion with the University of London: if it had none with psychical investigation either, that might explain the matter. Since then, however, the "Honorary Secretary of the University of London for Psychical Research" has given an exclusive film interview, which was advertised recently in the programme of the Gaumont-British Movietone News Theatre. "Psychical Research", in spite of the Principal, has clearly come into its own.

It is to be hoped that other learned bodies will follow suit: for example, The Royal (Spook) Society of London; The Marine Biological Association (for the Study of Sea Serpents); The Institution of Fire (-walking) Engineers; The (Psychical) Research Defence Society. My only personal fear is that the Anti-Vivisectionists may seize their opportunity and announce themselves as A.V. Societies.

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Nov. 26.

Kelvin's 'As if' in Physics

IN a letter appearing in the issue of NATURE for November 9, headed "Kelvin and the Age of the Sun", attention is very needfully directed to an instance of a complete misrepresentation of Kelvin's attitude towards a special problem.

A still more lamentable instance was given in a comparatively recent statement, by a leading worker, in which scorn was poured on Kelvin for his support of the so-called elastic-solid theory of the ether. One can scarcely avoid the conclusion that the worker had never read the "Baltimore Lectures", which deals with investigations as great and mind-satisfying as any of the truly great investigations of the present day. For, on p. 9 of the "Lectures", Kelvin says: "The luminiferous ether we must imagine to be a substance which *so far as luminiferous vibrations are concerned* moves *as if* it were an elastic solid. I do *not* say it *is* an elastic solid". (I have added the italics.) And, on p. 17, he says: "There is no way in which that can be explained by the rigidity of an elastic solid".

It is greatly to be desired that the "as if" of Kelvin were freely interspersed throughout many of the unqualified statements made regarding the conclusions to be drawn from the theory of relativity. An apt illustration of the need for this occurs in the letter, by Dr. Lanchester, which appears in the same issue of NATURE.

It cannot be said that we are without indications, for example, in connexion with Miller's work on ether drift, that it may yet be found necessary to return to, and develop, Kelvin's methods. The necessary "as if" is as safe in them as it is in an unillustrated equation. Co-ordinates ignored in an equation may actually be the most fundamentally active.

The idea that relativity first told us that, possibly, physical "things are not as they seem to be" is inconsistent with the history of natural philosophy.

W. PEDDIE.

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Nov. 11.

A New Technique in Cookery

THE authorities on cooking understand the effects of time and temperature[1] better than one might be led to suppose from Mr. Dufton's comments in his letter[2] under the above title.

The new technique is interesting, and has some obvious advantages over normal roasting, which demands experience, personal attention and a knowledge of cuts, but the meat is really *stewed* in its own juices for a very long time. It would be a tough joint indeed that resisted fifteen hours cooking at 212° F., if evaporation was prevented. Stews can be delicious, and are generally made from inexpensive meats.

In *roasting*, the centre of the joint never reaches 212° F.; for 'well done' meat the maximum recommended is 180° F. to 185° F. Hence only cuts which do not require prolonged hydrolysis can be roasted successfully. Tough meat has to be stewed or boiled for some hours because more drastic hydrolysis of the tissues is needed to secure a tender result. To do this in the ordinary oven, water must be added on account of evaporation; but the smaller the excess, the more flavoursome the meat: a large excess yields tasteless meat, but good broth.

Although fully appreciating Mr. (and Mrs.) Dufton's contribution to the economics and technique of stewing, we would point out that :

(1) high temperature ovens are required for other dishes ;

(2) the cooking of meat and, incidentally, of other foods, has been studied scientifically, though not exhaustively ;

(3) many people consider the appearance and flavour of outside cuts to be worth the trouble and expense of roasting.

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Putney, S.W.15.

[1] Vide "The Boston Cooking-School Cook Book", revised edition, 1933, p 239 *et seq.*
[2] NATURE, 136, 796, November 16, 1935.

Food and the Nation

I WAS disappointed not to find in the article under this heading in NATURE of November 18 any reference to the change that has taken place during the last half century in the manufacture of white bread.

In my young days, flour was produced by grinding wheat between millstones, whereby the skin of the grain (not the husk) was preserved in the flour. A notion having got abroad that the excellence of bread is in proportion to its whiteness, steel rollers were made to replace the millstones, whereby the grain was stripped of its dusky skin, with its valuable vitamin contents, and the baker was enabled to produce a whiter loaf.

Simultaneously with this change has grown the manufacture of margarine, coloured and flavoured to resemble butter, but with little, if any, of its nutritive quality. It is distressing to see children in our large cities fed chiefly on white bread and margarine.

In India, rice—the staple food of millions—is now milled in the same drastic way as wheat is in Europe, resulting in widespread mortality from beriberi.

Stone-ground flour is still produced in Great Britain. My own household is supplied with it from a mill in Horsham, and the bread baked from it is more agreeable in taste than the baker's ultra-white.

HERBERT MAXWELL.
Monreith,
Whauphill,
Wigtownshire.

WHAT Sir Herbert Maxwell says with regard to the loss of nutritional value through the widespread use of white bread and margarine is no doubt true enough ; but omission of reference to this point does not affect the economic relationship between food-production and consumption, with which the article was particularly concerned.

Editor, NATURE.

Points from Foregoing Letters

Helium produced from boron by neutron bombardment has been purified, observed spectroscopically, and measured by Prof. F. A. Paneth and H. Loleit. This seems to be the first case where an artificially produced element has been detected spectroscopically and measured by other than radioactive methods.

Dr. L. Szilard states that slow neutrons filtered by thick sheets of a strongly absorbing element like cadmium are strongly absorbed by thin sheets of indium and some other elements, though cadmium itself is transparent for such residual neutrons from cadmium. This is in contradiction to the conclusions usually drawn from current theory. The residual neutrons from cadmium show strong selective absorption effects, and are in some elements more absorbable than the unfiltered beam.

Dr. Hans von Halban, Jr., and Dr. Peter Preiswerk have determined the degree of activation produced in a silver plate by neutrons (from a radon-beryllium source) slowed down by passing through various thicknesses of water, alcohol, benzene and liquid paraffin. The difference in the effects observed suggests that the molecular structure of those compounds may affect the amount by which the velocity of the neutrons is reduced. The authors believe that the neutrons part with some of their energy in order to excite rotation and oscillation of the hydrogen atoms in those compounds.

A modification of Born's theory of the electromagnetic field has been suggested by M. H. L. Pryce to explain the existence of two different kinds of charged particles, electrons and protons, both with the spin $\frac{1}{2}$. Dr. Max Born calculates the mass of the proton by means of formulæ derived from that theory ; he arrives at the value 2,400, which is of the right order of magnitude. He points out that the theory allows for the transformation of a proton into a positron, with emission of radiation quanta of one thousand million electron volts, such as are found in cosmic rays.

T. L. Eckersley maintains that, notwithstanding the criticisms of Farmer and Ratcliffe and of Prof. Appleton, his previously suggested formula for the calculation of the frequency of collision of electrons in the upper atmosphere gives sufficiently accurate results.

Dr. R. D. Desai and Prof. R. F. Hunter state that they have carried out further experiments with methyl*cyclo*hexanones in order to test the Sasche-Mohr hypothesis, according to which four isomeric forms of certain derivatives of these compounds should exist ; but so far, they have been unable to obtain more than two isomeric cyanoarylamino derivatives.

C. W. Parsons reports that a pair of South American lung-fishes, living in a wooden tank containing mud and partly filled with water, maintained at 20° C., have bred after a period of some months during which they have been disturbed as little as possible. Twenty-two young fish (just post-larval) have appeared at the surface, representing the brood. This seems to be the first record of this fish breeding in captivity.

Knut Fægri states that, in dealing with biological classification, it is preferable to speak of "lines of evolution" rather than species. A line of evolution is a sequence of generations, the individuals of each generation grouping themselves according to the law of probability with regard to all essential features. Only by regarding the species as a momentary expression of the line of evolution, Mr. Fægri states, can the species concept be kept in conformity with the theory of evolution.

Research Items

Venezuelan Archæology

THREE new archæological sites in the State of Falcón, Coro, El Mámon and La Maravilla, in the important but little explored coastal area of northern Venezuela, have been described by Gladys Ayer Nomland (*Ibero-Americana*, **11**). They are situated in the midst of shifting sand dunes in the flat coastal strip at the edge of the plain, which lies between the inland range of mountains and the present coast line, and was left by the retreat of the sea with which it was covered in Pleistocene times to a distance of twelve kilometres inland. This flat strip must have served as a cultural highway between central and eastern South America. The location of the sites, excepting the hill-top site of El Mámon, was determined by the seasonal presence of dammed water in the gullies. The inhabitants lived by hunting and fishing. The absence of any signs of European contacts is strong presumptive evidence of a pre-Columbian dating. Notwithstanding the fragmentary condition of both pottery and skeletal remains, it is evident that the inhabitants practised urn burial, presumably as a secondary interment, judging from the size of the mortuary vessels, which could not have held a corpse entire. The artefacts from the sites consisted of pottery, implements of black and green stone, and ornaments of shell, pottery and stone. The pottery comprises a grey-brown ware, painted ware and a red ware. The ornament is geometric. In the Venezuelan fictile art, which is of a high degree of excellence, the plain red and grey-brown ware appear to form the basic substrata from which the more complex painted ware was developed. Certain groups can be differentiated, but phylogenetic relations are to be traced. The site of Coro, however, stands apart, the red ware diverging from the orderly progression into the highly complex incised group and not in the direction of the painted ware as elsewhere. This may be due to chronological difference, Coro probably being the earliest and La Maravilla, with its rich development of painted wares, the latest; but this is mere conjecture. The groups cannot be affiliated with any other datable groups.

Courtship of Manakins

THE manakins (not to be confounded with the fashionable variety!) are small passerine birds (family Pipridæ) inhabiting the tropical and sub-tropical regions of America, exclusive of the Antilles. They show courtship behaviour which in some species is complex, co-operative and well organised, and the existence of fundamentally similar habits among widely distributed and strongly differentiated members of the same family suggests that these are rooted in the origin of the family itself and are as much part of its evolution as is form. Frank M. Chapman has made a particular study of the courtship of Gould's manakin (*Manacus vitellinus vitellinus*) on Barro Colorado Island (*Bull. Amer. Mus. Nat. Hist.*, 68, 471, Sept. 1935). About a fortnight before courtship activities begin, the males commence to gather at an established *lek* or courting ground in the forest. The arrival of the breeding season is marked by the making of a 'court' from which the male removes all loose material, and into which the chief object of its existence is now to induce a female to enter. The courting ground generally contains from five to seven courts, thirty to forty feet from each other. Since the males have limited vocal powers, they announce their presence by making snapping and whirring sounds with their wing-feathers. When a female has once entered a court, there is no further competition for her favours by other males. The courting site has no immediate connexion with the nesting site, for the nest is built in a forked branch a short distance off the ground (twenty inches to five feet) usually a hundred yards or more from the nearest court.

Evolution of the Human Foot

HERBERT ELFTMAN and John Manter (*J. Anat.*, 70, Part 1, Oct. 1935) state that the fundamental similarity in architecture of the foot of the chimpanzee and that of man leaves no doubt as to the evolution of the human foot from that of an ape. Superimposed upon this structural similarity are important differences, considered in some detail, which the foot has undergone in evolution. The authors state that although the gorilla resembles man more closely than does the chimpanzee in the relative shortness of the lateral digits of the foot, it shows no indication of the more fundamental changes which are essential for the development of the human condition. "The fact that the human foot, adapted as it is for walking on the ground, bears a closer resemblance to the ape foot as used in arboreal than in terrestrial locomotion, may be regarded as another evidence of man's arboreal ancestry. It would also suggest that the essential features of man's foot were acquired at an early stage of his terrestrial existence, rather than after long apprenticeship on the ground."

Crustacea of Jehol

IN the report of the first scientific expedition to Manchoukuo under the leadership of Shigeyasu Tokunaga, June–October 1933 (Sect. 5, Div. 1, Part 2) various crustacea are described by Masuzô Uéno (Phyllopoda), Tune Sakai (Decapoda-Brachyura) and Hajime Uchida (terrestrial Isopoda and freshwater Amphipoda). Most of the text is in Japanese, but there are descriptions of species and bibliography in English, and all the papers are beautifully illustrated, some in colour. *Apus numidicus* was found in a swamp of alkaline water in the northern part of Jehol. It is a form typically inhabiting water of warm and arid regions of Africa and the south-western parts of Asia. The extension of its distribution into Manchoukuo from these western regions is probably due to the similarity of ecological conditions in both countries. Only one crab was collected by the expedition, *Eriocheir sinensis*, the mitten crab, which has now become notorious from its having been accidentally imported from China into Germany and settling there. It is now difficult to eradicate. Of terrestrial Isopoda, only one species was found, a new one, *Porcellio jehoensis*; and one new species of Amphipod, *Gammarus nekkensis*, inhabiting a cold spring, 1,000 metres above sea-level.

Plankton Production in the Southern Hemisphere

THE yearly cycle of events in the production of marine plankton has been followed for many years and in many places in the northern hemisphere. Similar observations are, however, to a large extent lacking from coastal waters in the southern hemisphere. It is therefore worthy of note that the yearly sequence has been followed in Australian waters off Sydney (Dakin, W. J., and Colefax, A., "The Marine Plankton of the Coastal Waters of New South Wales (1)", *Proc. Linn. Soc. N. S. Wales*, 58, Parts 3–4, 186–222; 1935). Collections made at fortnightly intervals throughout the year showed that in its main essentials the seasonal cycle is similar to that known for northern waters. The phytoplankton production shows two peaks, one in early spring and a smaller one in late summer. The spring outburst is not so markedly great as in northern seas; but it is of interest to find that the similarity extends also partially to the sequence of species, in that *Rhizosolenia* species follow those of *Chætoceros*. The zooplankton appears also to show two maxima, occurring respectively just after the two phytoplankton maxima. Tables are given for all the plankton catches, the organisms being identified to species so far as possible. This work forms a valuable foundation for further research on the plankton of Australian waters.

Primitive Colour-Pattern of Insect Wings

MR. HEMMING LEMCHE, of the Zoological Laboratory of the Royal Veterinary and Agricultural College, Copenhagen, discusses this subject in a recent paper (*Vidensk. Medd. fra Dansk naturh. Foren.*, 99, 45–64; 1935). His chief contention is that there exists in insect wings a primary colour-pattern, which can be traced back to an archaic pattern common to all insect groups. This archaic pattern comprises a number of cross-bands (most probably seven) separated by hyaline interspaces. He further points out that these archaic cross-bands traverse the wing in such a way that the bifurcations of the veins lie at the inner edge of the bands. It follows from this contention that the primary vein-forks cannot have been scattered irregularly over the wing, but have been located in cross-lines represented by the inner edges of the bands. The theory, it is claimed, is supported by evidence afforded by the most primitive fossil insects. Traces of the primitive banding are also retained among generalised Lepidoptera, in Mecoptera and in Acridiidæ among living forms. The present paper, it is stated, will be followed by more detailed studies which will form the subject of a later contribution.

Leaf and Scale Types in *Pinus*

WITHIN this single genus, indeed upon a single tree, are found four distinct types of branch system, long shoot, dwarf shoot, staminate cone axis and ovulate cone axis, and the generally accepted theories of this last cone would add yet another, the axis of the seed scales. Upon these varying branch systems are found no less than eleven types of foliar structures which include some leaf types, many scale types and the sporophylls. A most instructive analysis of these different foliar and branch types, of their development and structure and of their homologies, has been prepared by Dr. C. C Doak (*Illinois Biol. Mon.*, 13, No. 3, August 1935). Evidence for reduction of leaf number both in the fascicles of the short shoots and in the number of simple leaves or cotyledons in the seedlings thus emerges very convincingly, whilst the influence of the closely knit surrounding bud scales upon the shape and growth of the meristematic basal regions of the needles growing within is very clearly brought out. Alike in its extensive and clearly recorded observations upon some thirty-five species of pines and in its extensive and critical survey of the relevant literature, this monograph will have permanent value as a contribution to some of the most intriguing problems of shoot morphology.

Asparagus Cultivation

A SHORT note by Mr. A. N. Rawes (*J. Roy. Hort. Soc.*, Oct. 1935) gives some very useful information about the cropping of *Asparagus*. Several series of beds containing all male plants were compared with beds planted with female crowns. The result showed that in every case the male plants yielded about 60 per cent more saleable stems than the females. The series covered a variety of planting methods and differing cultivation, but the superiority of the males was obvious in every case. Very little difference in the relative grades of produce was, however, demonstrable between the two sexes. The paper reports a continuation of previous experiments made at the Wisley gardens, with confirmation of the earlier results, and also discusses the merits of close and wide planting.

Antarctic Moraines

IN his presidential address to the Australian and New Zealand Association for the Advancement of Science, 1935, now reprinted in pamphlet form, Sir Douglas Mawson gave a lengthy review of the unveiling of Antarctica, and discussed several of the problems which that continent presents. He stressed the evidence of the former much more extensive glaciation and noted particularly the recent recognition of terminal moraines on the sea floor often fifty to one hundred miles beyond the real coast line. These moraines are frequently hundreds of feet in height. Off Adelie Land the height of the chief off-shore moraine is about three thousand feet. It is the occurrence of these submarine banks that has much to do with the ice-obstruction that prevents access to certain coasts of Antarctica. Huge icebergs become grounded in 600–1,000 ft. of water and hold up floating pack, and thus coastal waters are blockaded. It is noticeable that where the sea floor is down-faulted, as on the west of the Ross Sea or the east of the Weddell Sea, deep water prevents these moraines acting as barriers to moving ice. Such shores are relatively accessible. It is only the action of periodic super-tides as described by O. Pettersen that moves the more securely anchored ice obstructions.

Earthquakes and Rainfall

MR. J. F. BRENNAN, Government meteorologist in Jamaica, has recently made an interesting comparison between the mean monthly frequency of earthquakes and the mean monthly rainfall in Jamaica (*Earth. Notes, East. Sect. Seis. Soc. America*, 7, 25–26; 1935). During the years 1908–34, 480 earthquakes were recorded. The curve representing the mean monthly frequency shows two maxima, in February (60 earthquakes) and July (46), both months of minimum rainfall, and two minima in May (25) and

October (31), months of maximum rainfall. The author suggests that the greater frequency of earthquakes during the dry seasons may be due to the withdrawal of water from underground water-courses, which may thus facilitate the fall of large masses of rock.

Irrigation Research

THE Punjab Irrigation Research Institute has issued two further reports of its work. In "Protection below Khanki Weir" (2, No. 8, Nov. 1934), Mr. J. P. Gunn gives an account of the experiments made, by means of models, to determine an effective and simple method of preventing scour at the reconstructed portions of the Khanki Weir, which is built on a sand foundation. The arrangement adopted and incorporated in the new works consisted of three rows of 'arrows' pointing upstream, followed by several rows of control blocks, as it had been found that this gave a low velocity of flow at the bottom without local turbulence and had the effect also of raising the level at which maximum velocity occurred sufficiently near the surface of the water to stabilise the scour. The results in practice are so far reported as satisfactory, but a complete investigation could not be made until the fall of the river. In the second of these reports, entitled "Influence of an Upstream Sheet Pile on the Uplift Pressure on a Floor" (2, No. 9, Jan. 1935), Dr. N. K. Bose, mathematical officer, and H. L. Uppal, assistant research officer, present the results of one of a series of experiments directed towards ascertaining the influence of different arrangements of sheet piling on the distribution of floor pressure. The work has involved extensive observation and mathematical analysis of the data obtained, and from it two general conclusions are drawn: namely, that, length for length, a long sheet pile is less effective than a short one, and that the longer the sheet pile the less effective is the floor. As the investigation proceeds, it is hoped to be able to determine data for safe and economical dimensions under varying working heads.

Solar Radiation and Weather Studies

IN "Solar Radiation and Weather Studies" by C. G. Abbot (*Smithsonian Miscellaneous Collections*, 94, No. 10) an account is given of an investigation begun by Dr. S. P. Langley, formerly secretary of the Smithsonian Institution, into the dependence of weather on variations in the radiation emitted by the sun. While few physicists or meteorologists are likely to dispute the probability of a connexion between the two, some may doubt whether the problem of measuring the solar radiation, which involves various assumptions about the relation between its intensity outside the earth's atmosphere and at the point where measurement is made, has been solved, and may regard any apparent variations of the intensity, after due allowance has been made for the varying distance between the earth and the sun, as mere errors of measurement and computation. Such doubts may perhaps be dispelled by the generally close resemblance found between graphs representing the day to day values of the solar 'constant' obtained by measurements made at places so far apart as Montezuma (Chile), Table Mountain (California) and Mount Brukkaros (South West Africa) illustrated in this work. The solar variations on which the comparisons in this discussion are mainly dependent are those revealed by ten-day means of the solar 'constant' for the period 1920–34. A number of periodicities ranging from 7 months to 68 months were revealed by a variant of the periodogram method of analysis, and these suggested the existence of a well-marked 23-year period. For tracing the connexion between these and weather, use has been made of long meteorological records collected together in an earlier Smithsonian Publication—"World Weather Records". Considerable success is claimed in this, and practical application of the results was made in long-period forecasts for 1934, 1935 and 1936; it is stated that these were fairly well verified for temperature and precipitation in 1934.

Vibration of an Incomplete Circular Ring

FINDING that Lamb's method of treatment is applicable only to relatively small arcs of rings, Mr. T. Ikebe has investigated, by means of a mathematical analysis, the frequency and form of vibration of a ring having a very small air gap ("On the Vibration of an Incomplete Circular Ring", *Sci. Pap. Inst. Phys. and Chem. Res., Tokyo*, 27, No. 589). His investigation is based on equations given by Prescott in "Applied Elasticity", and proceeds by the application of Ritz's method and of an integral equation to determine values of the frequency of a ring of negligible cross-sectional dimensions. Comparison of these results with those obtained experimentally reveals marked discrepancies, which are considered to be due to the effect of rotational energy in the test ring, the radial thickness of which cannot be regarded as negligible. A further investigation, giving effect to the influence of rotational energy, yields more comparable results; but as the experiments were carried out on a magnetised ring and in a magnetic field, some doubt is expressed as to the effective value of Young's modulus and as to the condition of free oscillation.

A Method of Improving the Radio Beacon

IN 1929, the Air Ministry erected an improved rotating beacon at Orfordness, Suffolk, for direct navigational use in the North Sea. Mr. H. A. Thomas has discussed the possible errors of this method when the navigator uses it to find the direction of the beacon from the ship (*J. Inst. Elec. Eng.*, 77, 285). An analysis of the records of bearings taken on this beacon by ships at sea shows that within a range of 100 miles, about 80 per cent of the bearings obtained were correct within 2°, whether taken by day or by night. At greater distances the day observations showed reasonable consistency up to 250 miles, but the night observations gave evidence of the well-known 'night effect' errors. These effects are known to be due to interference at the receiver on the ship between the ground ray and other rays which have travelled through the upper atmosphere. These produce false bearings owing to the lack of definiteness of the minimum points. With the operating frequency 288·5 kilocycles (1,040 metres) at present allocated to rotating beacons, it is necessary to use a large aerial system, and rotating this produces mechanical difficulties. In the system described by Mr. Thomas, there are two pairs of spaced aerials supplied by two power amplifiers. These amplifiers, automatically controlled, provide the necessary voltage variations. Experiments show that a controller of this type can advantageously fulfil the function of an excitation apparatus. It is concluded that the system would be suitable for incorporation in a full-sized rotating radio beacon for marine navigational purposes.

British Institute of Radiology: Annual Congress and Exhibition

THE ninth Annual Congress and Exhibition of the British Institute of Radiology was held in the Central Hall, Westminster, on December 4–6. As usual, one session was devoted to the reading of papers on the physical and technical aspects of X-rays as applied to medicine.

Dr. J. Read, of the Radium Institute, gave a lecture on "High Voltage X-ray Tubes in the U.S.A.", in which he traced the development of continuously evacuated tubes for voltages up to one million volts. The first tube of this type, constructed by Lauritzen at the Kellog Laboratory, Pasadena, in 1927, was successfully operated at 600 k.v. peak supplied by an alternating current generator comprising four transformers in series. The tube, which was self-rectifying, had a glass envelope some nine feet long and an earthed anode. A later tube of the same type has a central earthed discharge-chamber and a balanced arrangement of electrodes, one at 500 k.v. positive potential to earth and the other at 500 k.v. negative potential to earth, so that the peak potential difference between the electrodes is 1000 k.v. Whereas the earlier tube made use of the 'cold emission' of electrons, the later tube has a shielded hot filament. Special vacuum pumps, first of the mercury vapour type with liquid-air traps and later of the oil vapour type, were designed. The latest pump has a pumping speed of 2,000 litres per second.

A somewhat similar X-ray tube excited by alternating voltages up to 100 k.v. peak has been installed at the Soiland Institute. In this tube, the glass envelope is replaced by a porcelain one consisting of a large transformer bushing insulator, this permitting a considerably smaller over-all length. At Lincoln (Illinois) and at the Harper Hospital, Detroit, similar tubes are operated by constant voltage generators. Rather different types of tubes and generators are installed at Seattle and at Chicago. In these installations, the high-tension generators consist of two Villard generators connected in series, and the tubes are built in a cascade arrangement so that the electrons are subjected to successive accelerations. This design reduces the cold emission of electrons, but requires a considerably better vacuum than the Lauritzen design. A further difficulty in operating such tubes arises from the fact that, owing to the long electron path (some 10 feet) the electron beam is deflected by magnetic fields to a serious extent. The effect of the earth's field may be balanced out by suitably disposed magnets, but even so the focus is apt to wander.

Dr. Read also described an ingenious arrangement devised by Sloan at the San Francisco hospital. In this outfit, the high-tension generator consists of an oscillator generating high-frequency waves of 6 metres wave-length, coupled as in a Tesla transformer to a tuned secondary. The transformer is mounted in an evacuated tank, and the high-potential end of the secondary carries the target of the X-ray tube, the filament being mounted in the side of the tank. The high-tension transformer and X-ray tube are thus mounted in the same vessel, and the complete outfit is considerably smaller than those previously considered. Some difficulties are experienced owing to mechanical vibrations of the high-tension coil, and the efficiency of the generator is rather low, an input power of about 100 k.w. being required to give a reasonably powerful X-ray beam.

Dr. L. H. Gray, of the Mount Vernon Hospital, gave a paper on "The Ionisation Method of Gamma Ray Energy Measurement", in which he showed theoretically that the degree of ionisation produced in light elements can be related to the energy of the radiation, and measured by ionisation in air. The possibility of measuring gamma ray energies by ionisation depends on two factors: (1) The energy required to produce an ion pair in air must be independent of the velocity of the ionising electrons; and (2), the ratio of the stopping powers of air and other materials for electrons must be independent of the velocity of the electrons. Reviewing the experimental evidence, he is of opinion that both these conditions are fulfilled. In the case of heavy elements, the degree of ionisation is relatively higher, due to the fact that the absorption process is not wholly one of scattering, but is partly photo-electric. In aluminium the ionisation is some 10 per cent higher than in carbon, and in lead more than four times as great.

The eighteenth Silvanus Thompson Memorial Lecture was given by Dr. G. W. C. Kaye, of the National Physical Laboratory, on "Forty Years of Radiology (1895–1935): A Review and Some Reminiscences". Observing that, almost to the day, forty years have passed since Rontgen's discovery of the radiation that bears his name, Dr. Kaye reviewed in a fascinating manner the history of the subject, starting from the early gas X-ray tubes excited by induction coils, passing on to Coolidge's invention of the hot cathode tube (1913), Bouwer's development of the self-protected tube and the recent advances of various types of shock-proof equipment. High-tension generators, he said, beginning as induction coils and made by instrument makers, have become more and more powerful, and modern equipment follows closely the lines of other branches of electrical engineering. Apart from everyday apparatus in use in all hospitals, there is a tendency, particularly in the United States, to experiment with much higher voltages, and generators and tubes operating at one million volts have been described. In Great Britain, X-ray treatment with 400 kilovolt X-rays is being carried out in several hospitals in London, Leeds, Manchester and Birmingham.

Reviewing the question of dosage, Dr. Kaye stated that the ionisation unit of X-ray quantity, the rontgen, has practically replaced the older arbitrary standards such as the pastille dose. Recent research, he said, appears to show that the röntgen will also serve as a unit of gamma-ray dose. Touching briefly on radium therapy, Dr. Kaye remarked that since 1913 the National Physical Laboratory has measured about a quarter of a pound of radium, of value more than a million pounds, the bulk of this radium being the property of the National Radium Trust. Mention was also made of the industrial and physical applications of X-rays in the radiographic and fluoroscopic examination of objects and the study of the solid state of matter by crystal analysis.

Lightning Stroke Currents

RECENT laboratory researches on impulsive rushes of electricity produced by high-voltage discharges of condensers have proved of great value by leading to improvements in the methods used in protecting buildings and overhead wires from damage by lightning strokes. The discharge in the laboratory is very similar to the lightning stroke in Nature. The sound produced, although the arc is only a few feet long, is uncomfortable and often painful to the ear. Anyone taken unawares by a laboratory discharge occurring a few feet away might be seriously affected by the blinding light and the deafening noise produced.

In a paper read at the Pacific Coast Convention of the American Institute of Electrical Engineers, Seattle, Mr. P. L. Bellaschi gives definite and interesting information about lightning strokes. Statistics prove that most of them are single discharges. The number of multiple discharge strokes is about 20 per cent, and the number of oscillations is very seldom greater than four. Field observations show that multiple discharges sometimes strike the ground at appreciable distances apart. Hundreds of cases are known where bronze conductors, used in telephone circuits, which are about 2 square millimetres in cross-section have been fused by lightning. A case has been reported where lightning has vaporised a 3·34 sq. mm. copper conductor. Several thousands of wood poles used for telegraphs and protected by 21 sq. mm. steel wires connected to the earth have been kept under observation for several years. None of the wires was found fused and none of the poles was damaged, although previously to being protected they were often found shattered.

Assuming that an ordinary lightning stroke fuses a 2 sq. mm. bronze conductor, and that it consists of a single discharge, then on the basis of a duration of 40 microseconds, the maximum value of the current produced by the stroke would be of the order of 100,000 amperes. On the basis of a 100 millionths of a second duration, the current would be of the order of 65,000 amperes. The data available show that currents as high as 200,000 amperes would be very rare.

Photographs are shown of copper tubes that have been crushed inwards by lightning discharges. In one case a hollow copper rod 1·47 cm. inside diameter and 6·675 mm. thick was crushed by lightning. From the incipient fusion shown in several places, the rod was obviously raised to a high temperature. The crushing force was calculated to be 400 lb. per sq. inch of tube surface. An oscillatory discharge would considerably increase this crushing force.

Lightning strokes to guy wires have blasted the rock, cement, etc., in which the wires were embedded. The shattering of poles and trees is a familiar occurrence. Parts of shattered objects have been thrown distances of more than a hundred feet. Metal pipes have been cracked and broken open by lightning. Experiments are quoted which show that the diameter of the lightning stroke channel generally lies between one and two centimetres.

Aluminium in Food

STATEMENTS appear from time to time incriminating the use of aluminium cooking utensils as dangerous to health, the small amounts of the metal that are dissolved by the food being considered responsible for the occurrence of various human ailments. As often as such allegations have been made they have been denied, and the question is not yet settled. There is no doubt that the ingestion of relatively large amounts of aluminium produces toxic symptoms, but it is not so simple to prove the toxicity to human beings of the minute amounts which are non-toxic to animals. In any event, knowledge of the amounts of the metal likely to be met with in cooked foods and of the amounts producing symptoms in animals is a prerequisite to a discussion on the subject. Such information is provided in a recent review by Monier-Williams*.

Alum itself has in the past been used as the acid ingredient of commercial baking powder and is still so used in some countries: bread made with such a baking powder may contain as much as 0·05 per cent of aluminium, or 500 parts in a million. The amount found in foodstuffs is much less and a large part of that found in plants is probably adventitious in origin, due to contamination with soil and dust. Probably the amount consumed daily with food is of the order of 5–10 parts, or less, per million. In animal organs the quantities are of the order of 1–2 parts in a million.

The accurate determination of aluminium in food and biological material is a difficult matter. Monier-Williams describes a method in which 8-hydroxyquinoline is used as a precipitating agent for aluminium. It has the advantage that the compound with aluminium contains only 5·9 per cent aluminium, so that small amounts can be determined with great accuracy; the precipitate can be weighed or titrated with bromine.

The amount of aluminium taken up by food during cooking varies greatly with its nature, especially its acidity, and the conditions of cooking as well as with the particular utensils used: the purer the metal employed in the latter the more resistant is it to corrosion. Probably less than 10 parts in a million

* Ministry of Health. Reports on Public Health and Medical Subjects, No. 78: Aluminium in Food. By Dr. G. W. Monier-Williams. Pp. 34. (London: H.M. Stationery Office, 1935.) 9d. net.

is usually the amount occurring in food cooked in aluminium vessels. It appears that a considerable proportion of the metal taken into the stomach is soluble, but the actual amount dissolved varies greatly with the circumstances. Only minute amounts, however, appear to be absorbed into the body, from determinations of the quantity in the blood, tissues or urine. The presence of relatively large amounts of the metal in the digestive tract may interfere with the digestive processes, alum especially producing gastro-intestinal irritation and loss of appetite in both animals and man.

Neither these experiments nor those which show the harmlessness of the ingestion of small amounts of aluminium are necessarily conclusive, since it is possible that there may be individuals who are susceptible to even such small doses of the metal as may be derived from aluminium utensils. Monier-Williams concludes that there is no convincing evidence that these small amounts have a harmful effect upon the ordinary consumer, but that it is undesirable to admit the entry of aluminium into food in the relatively large amounts in which it may be employed as a constituent of baking powders or self-raising flour.

Phytoplankton and Herrings*

THE concentration of phytoplankton organisms at times in dense patches in various parts of the sea is a phenomenon, which was recognised by early observers (see also NATURE, Dec. 7, p.897). These brownish or greenish patches in the North Sea, usually formed of the diatoms *Rhizosolenia* or the colonial flagellate *Phæocystis* and accompanied by a slime which clogs the nets are well known to the fishermen, who call such discoloured water 'stinking water', 'weedy water', 'Dutchman's baccy juice', etc., regarding it as a bad sign for the fishing. The present authors analyse the herring fishery of the southern North Sea together with the occurrence of these phytoplankton patches, the object of the work being "to give an account of our knowledge of the distribution and movement of any dense phytoplankton concentrations in the southern North Sea from 1921 to 1932 (excepting years 1928 and 1929) at such times as might affect the herring fishing, and by examining the official reports and statistics of the fisheries from year to year to see whether or not the existence of these patches, either on the fishing grounds themselves, or lying in the path of incoming shoals of fish, can be regarded as a probable cause of some of the fluctuations in the herring landings over this period."

It has been found again and again that where large zones of phytoplankton occur the herrings avoid them, sometimes making extensive detours rather than penetrate them, and that these patches form definite barriers to the oncoming shoals.

At the time of the great herring shoaling in the southern North Sea, *Rhizosolenia styliformis* and *Phæocystis* are the outstanding features of the plankton in this area, and when the fish have been plentiful and the fishing above the average, no instance is found of a concentration of plankton in such a position where it might be held to have an influence on the fishery, whereas on each occasion when the fishery has been below the average and the decrease cannot be attributed to weather or economic conditions, phytoplanktonic concentrations occurred. Four factors are cited as possibly influencing the fishery—the effect of the moon, year classes, gales and economic conditions; to these are now added the very probable and now almost certain factor of influence of phytoplankton.

The authors note further that since the present paper was being prepared for press another autumn season has come round, 1933, and this brings with it such striking evidence in favour of the phytoplankton hypothesis that they feel justified in regarding this as not only possible but even highly probable.

* Ministry of Agriculture and Fisheries. Fishery Investigations, series 2, vol. 14, No. 2, 1934: Phytoplankton and the Herring. Part 1: 1921 to 1932. By R. E. Savage and Prof. A. C. Hardy. Pp. 73. (London: H.M. Stationery Office, 1935.) 3s. 6d. net.

Educational Topics and Events

CAMBRIDGE.—N. G. Hentley, of St. John's College, has been appointed to the Benn W. Levy research studentship in biochemistry.

At Queens' College, Sir C. J. H. Thomas, Permanent Secretary of the Ministry of Agriculture and Fisheries, has been elected into an honorary fellowship.

Mr. C. W. Gilbert, of Christ's College, has been elected into a research fellowship at Jesus College.

An election to the Pinsent-Darwin studentship in mental pathology will be made in January 1936. The studentship is of the annual value of not less than £225, and is tenable for three years. The student must engage in original research into any problem having a bearing on mental defects, diseases or disorders, but may carry on educational or other work concurrently. Applications should be sent before January 1, 1936, to the Secretary, Pinsent-Darwin Studentship, Psychological Laboratory, Cambridge.

ELECTIONS to three Beit fellowships for scientific research will take place on or about July 10, 1936. A fellowship is of the annual value of £240, and is tenable for two years at the Imperial College of Science and Technology, South Kensington, London, S.W.7. Candidates must be less than twenty-five years of age. Further information can be obtained from the Rector of the College.

THE thirty-sixth annual meeting of the Science Masters' Association will be held in the Chemistry Department of the Imperial College of Science and Technology, South Kensington, London, S.W.7, on January 1–4, under the presidency of Sir William Bragg. The following lectures will be delivered during the meeting: Sir William Bragg, "School Science after School" (presidential address); Prof. J. C. Philip, "Chemical Fogs"; Prof. J. W. Munro, "Recent Advances in Economic Entomology"; Dr. H. J. T. Ellingham, "Primary Cells: their Nature and Action"; Dr. John Taylor, "The Doctor as Detective". There will also be a lecture-demonstration of biological films by H. R. Hewer. Among the discussions to be held is one on "Geometrical Optics—especially Sign Conventions" and another on "School Certificate Biology Syllabus". Further particulars can be obtained from the Annual Meeting Secretary, The Square, Repton, Derby.

Science News a Century Ago

Meeting of the Royal Geographical Society

AN ordinary meeting of this Society was held on Monday, December 14, 1835, at its rooms in Regent Street. The president, Sir John Barrow, "announced that the Council had decided that His Majesty's annual premium should be awarded to Captain Back, on account of his recent discoveries, and particularly of a large river running beyond the Great Slave Lake a distance of 500 miles. He felt convinced that the south land seen by Captain Back was the coast of North America, and this convinced him of the possibility of a north-western passage. He was happy to state that the Council had decided in Captain Back's favour on no other authority than that of his simple and affecting narrative. So closely had he been within starvation that he had been compelled, on one occasion, to eat his own shoes; yet notwithstanding the great sufferings which he had undergone, he had come forward gratuitously to the assistance of his 600 fellow-countrymen who were now enclosed in the ice on the shores of Greenland with no other prospect before them than death. He was happy to announce that Captain James Ross had previously offered his aid to the Admiralty, which, he had every reason to believe, would be accepted." (*Courier*.)

Central Agricultural Society of Great Britain and Ireland

As the result of a largely attended meeting held on December 15, 1835, at the Freemasons' Tavern, Great Queen Street, a society called the Central Agricultural Society of Great Britain and Ireland came into existence. At the meeting, Mr. Ormsby Gore, M.P., was in the chair, while the Earl of Stanhope was the principal speaker. A few days later, on December 21, the Society published a notice in *The Times*, stating that at a meeting of the Committee held on December 16, at 448 West Strand, London, it was resolved that the objects of the Society "be exclusively national; directed to no theoretical purposes but formed solely with a view to procure the co-operation of the owners and occupiers of land in every practicable measure which can afford relief to the present distressed state of agriculture . . . and with a view to improvement in every branch of practical agriculture".

Manufacture of Machinery in Germany

ON December 18, 1835, *The Times* quoted the following extract from a Frankfort paper: "We have much cause to rejoice at the great advance which has been made in Prussia within these last few years in the manufacture of machinery. It is not very long ago, for almost every large machine, we required help from England, and had the greater part from that country. Now an entire change has taken place in this respect, and the great establishment of this kind in Berlin, furnishes the most complete and admirable machines at far lower prices than in England. These happy results we owe to the zeal of Privy Councillor Beuth, who, as President of the Mechanics' Institution and Director of the Department of the Interior, does everything to favour and improve the construction of machines". Beuth was born at Cleve in 1781 and died in Berlin in 1853. A statue of him was erected in 1861.

Monument to Laplace

ON December 19, 1835, the *Athenæum* stated: "A monument has been raised to this great man at Beaumont, and placed on the site of the house where he was born. It is a building erected for the purposes of a primary school, and a hall for the mayoralty. Two tablets of marble are inserted in the front of the building, on one it is recorded that the corporation of Beaumont had erected their edifice to the memory of Laplace, born at Beaumont, the 22nd of March 1749 and died at Paris the 5th March 1827. On the other is inscribed:

'Sous un modeste toit, ici naquit Laplace,
Lui qui sut de Newton agrandir le compas,
Et, s'ouvrant un sillon dans les champs de l'espace
Y fit encore un nouveau pas.' "

Societies and Academies

DUBLIN

Royal Dublin Society, November 26. G. F. MITCHELL: A recent bog-flow in Co. Clare. On October 29, 1934, a mountain bog burst above an escarpment which interrupted the gentle slope of the hillside. The bank of well-drained peat overlooking the escarpment gave way, allowing the bog above that level to flow away violently. It is suggested that the heavy rainfall (more than 2 in.) in the vicinity in the preceding week had increased the weight of the bog, and caused the supporting bank to give way. E. J. SHEEHY: The mechanical aspect of the nutrition of farm stock. Insufficient recognition of the mechanical effect of foods explains the absence of uniformity sometimes occurring in the results of different laboratories, and also the frequent conflict of opinion between the scientific worker and the practical feeder. Certain foods have, in particular circumstances, a nutritive value in excess of their net energy value. G. CRUESS-CALLAGHAN: The application of the catalase test to butter. An analysis of the large number of results published by Knudsen (probably for butter made from ripened cream) yields a value about $-0{\cdot}4$ for the coefficient of correlation between the catalase figure and the quality of the butter, and about the same value for the coefficient for the catalase figure and the keeping property. Reasons are suggested for the varying coefficients, ranging from $-0{\cdot}191$ to $+0{\cdot}96$, put forward by other workers.

PARIS

Academy of Sciences, November 12 (*C.R.*, 201, 861–916). AUGUSTE BÉHAL: Scientific bibliography. EDGAR BATICLE: The problem of distribution. GÉZA KUNETZ: The conservation of the Spearman common factor in a linear substitution. NIL GLAGOLEFF: Axioms of appurtenance of Euclidian geometry. MARCEL VASSEUR: Tangential invariants relating to the conjugated network common to two applicable surfaces. FRÉDÉRIC ROGER: The relation between the tangential and metric properties of Cartesian ensembles. N. ARONSZAJN: The metric characterisation of Hilbert space, of vectorial spaces and of certain metric groups. EDOUARD CALLANDREAU: The variation of the influence round a point. PIERRE CHEVENARD and XAVIER WACHÉ: The acceleration of a structural reaction in a steel by the effect of a mechanical constraint. Experiments on a chrome-

vanadium-molybdenum steel. Tests on the steel under load at temperatures between 450° and 600° C. show important changes. As neither the measurements of resistance, expansion or magnetisation showed any appreciable physiochemical modification, the softening observed must be due to a structural modification of the alloy. It is pointed out that these facts must be taken into account when designing machines required to work at a high temperature. MARIUS AUBERT, PIERRE CLERGET and ROGER DUCHÊNE: The influence the addition of various substances on the combustion of gas oil in injection motors. Study of the effect of adding ethyl nitrate to the gas oil in regulating the combustion and suppressing detonation. HENRI CAMICHEL: The constants of the movement of the *F*-type stars. LÉON DUBAR: The internal and superficial conductivity of cuprous oxide. Cuprous oxide possesses a very high superficial conductivity, which is reduced by the adsorption of water vapour. MLLE. SUZANNE VEIL: An electrometric control of displacement reactions. GEORGES BRUHAT and LOUIS WEIL: The rotatory power of quartz for rays perpendicular to the optic axis and its dispersion between 2537 A. and 5780 A. In the whole of the interval of the spectrum studied the rotatory dispersion of quartz is the same for rays perpendicular and parallel to the axis. JEAN LAVAL: The diffusion of X-rays varies in a discontinuous manner with the angle of diffusion. EDMOND ROTHÉ and MME. A. HÉE: The radiometric exploration of a rhyolite *coulée*. The rhyolite near Welschbruch is strongly radioactive, and it has been found possible to map out the volcanic *coulées* by radiometric measurements. OSIAS BINDER: The hydrolysis of solutions of copper sulphate. VICTOR HENRI and PIERRE ANGENOT: The relation between the ultra-violet absorption spectrum and the Raman spectrum of pyridine. The analysis of the ultra-violet absorption spectrum of pyridine vapour proves the existence in the lower level of the molecule of five fundamental frequencies. These correspond with the Raman spectra of pyridine and benzene. JEAN TABUTEAU: The application of the Raman effect to the study of the *cis-trans* isomerism of the methylcyclohexanols. It has been proved that the Raman spectra of the *cis* and *trans* isomers are different and the variations are greatest for frequencies between 300 cm.$^{-1}$ and 900 cm.$^{-1}$. PIERRE CARRÉ and HENRI PASSEDOUET: The influence of an element or a negative group on the relative mobilities of alkyl radicals in their chloroformates. GEORGES LÉVY: The nitration of α-ethylnaphthalene. GEORGES DARZENS and ANDRÉ LÉVY: The preparation of 1, naphthyl-β-propionic, 2, naphthyl-β-propionic and 2, tetrahydronaphthyl-β-propionic acids. The synthesis of dihydrophenalone and of 5, 6-tetrahydrobenzo-1-indanone. ANDRÉ GUILLEMONAT: The oxidation of 3-methyl-2-pentene and of 2-methyl-2-pentene by means of selenious anhydride. MOSHEH AVNIMELECH: The Vindobonian in Palestine. FERNAND JACQUET and THÉODORE MONOD: The fossiliferous Primary of the south of Mauritanian Adrar. RENÉ SOUÈGES: The embryogeny of the Resedaceæ. The development of the embryo in *Reseda Luteola*. JEAN RÉGNIER and ANDRÉ QUEVAUVILLER: The concomitant variations of chronaxy and of nervous excitability under a pharmacodynamic influence (action on the motor nerve of *Rana esculenta* of cocaine and its substitutes). MLLE. CATHERINE VEIL: The mechanism of the colour change in fishes.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, December 14

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.—Prof. G. Hickling: "William Hutton's Observations on Coal, 1833".

BRITISH PSYCHOLOGICAL SOCIETY, at 3.—Annual General Meeting.
Prof. J. Drever: "The Status and Qualifications of Professional Psychologists" (Presidential Address).

Sunday, December 15

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J. Edwards: "Pests".*

Monday, December 16

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "Pouched Mammals".*

Wednesday, December 18

INSTITUTION OF CIVIL ENGINEERS, at 6.30.—Prof. A. H. Gibson: "Tidal and River Models" (Vernon-Harcourt Lecture).

Official Publications Received

Great Britain and Ireland

International Tin Research and Development Council. Miscellaneous Publications. No. 4: Tin and its Uses. By D. J. Macnaughtan. Pp. 16. Free. No. 5: Tin and Civilisation. By D. J. Macnaughtan. Pp. 9. Free. Technical Publications. Series A, No. 22: Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin. By A. W. Hothersall and W. N. Bradshaw. Pp. 16. Free. Series A, No. 24: The Atmospheric Corrosion and Tarnishing of Tin. By L. Kenworthy. Pp. 17. Free. Series A, No. 25: Electrodeposition of Tin Alloys from Alkaline Stannate Baths. By R. G. Monk and H. J. T. Ellingham. Pp. 12. Free. (London: International Tin Research and Development Council.) [2911

Other Countries

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 39, Part 1: The Isolation and some Cultural Characters of *Bacillus cellulosæ dissolvens*. By Jun Hanzawa and Sadahiko Yoshimura. Pp. 48+1 plate. (Tokyo: Maruzen Co., Ltd.) [2911

Territory of Papua. Anthropology, Report No. 16: The Blending of Cultures; an Essay on the Aims of Native Education. By F. E. Williams. Pp. iii+46. (Port Moresby: Government Printer.) 1*s*. [3011

Tide Tables for the Atlantic Coast of Canada for the Year 1936: including the River and Gulf of St. Lawrence, the Bay of Fundy, Northumberland and Cabot Straits, Hudson Bay, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. (Fortieth year of Issue.) Pp. 96. Ottawa: Government Printer.) [3011

Report on the Administration of the Meteorological Department of the Government of India in 1934–35. Pp. ii+35+1 plate. (Delhi: Manager of Publications.) [212

Comisión de Estudio del Túnel submarino de Gibraltar. El Túnel submarino de Gibraltar: Estado actual de los trabajos. Pp. 118+5 plates. (Madrid: Comisión de Estudio del Túnel submarino de Gibraltar.) [212

Royal Agricultural Society. Summarised translation of Bulletin No. 20, Chemical Section: Preliminary Investigations on the Phosphoric Acid Supply in the Soils of the Bahtim Permanent Experiments. By Ahmed Mahmoud. Pp. 47. Summarised translation of Bulletin No. 21, Chemical Section: Phosphatic Fertilisers, Comparative Trials on Immediate and Residual Effects. By Ahmed Mahmoud. Pp. 30. (Cairo: Royal Agricultural Society.) [212

Indian Forest Records. New Series, Vol. 1, No. 5: Neue Attelabiden aus Indien (Curculionidæ, Col.) Von Eduard Voss. Pp. ii+95–104. (Delhi: Manager of Publications.) 5 annas; 6*d*. [212

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 7: A Siltometer for Studying Size Distribution of Silts and Sands. By Dr. Amar Nath Puri. Pp. 6+4 plates. 5 annas, 7*d*. Research Publication, Vol. 4, No. 7. Soil Deterioration in the Canal Irrigated Areas of the Punjab. Part 1: Equilibrium between Ca and Na ions in Base Exchange Reactions. By Dr. E. McKenzie Taylor, Dr. Amar Nath Puri and A. G. Ashgar. Pp. 15+4 plates. 8 annas; 9*d*. Research Publication, Vol. 4, No. 8: Soil Deterioration in the Canal Irrigated Areas of the Punjab. Part 2. Relation between Degree of Alkalisation and Dispersion Co-efficient in Deteriorated Soils. By A. G. Ashgar, Amar Nath Puri and E. McKenzie Taylor. Pp. 7+4 plates. 4 annas; 5*d*. (Lahore: Punjab Irrigation Research Institute.) [212

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 18: Paleoantropología Argentina. Edición Oficial ordenada por El Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 704+33 plates. (La Plata: Director de la Edición Oficial de Obras de Florentino Ameghino.) [312

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3451 SATURDAY, DECEMBER 21, 1935 Vol. 136

Scientific Humanism

IN the preface of his admirable volume on the history of seventeenth century science, Prof. A. Wolf pleads for a new orientation in humanistic studies. The need for such a re-orientation, repeatedly urged in the columns of NATURE, is becoming more evident daily. On the Continent, reasonable persuasion and confidence in public education are increasingly regarded as exploded liberal superstitions. Blind obedience to leaders with supposedly exceptional gifts is more in keeping with the temper of the times, and if we record with gratitude the fact that Britain and the Scandinavian countries are least swayed by it up to date, it is all the more important to forestall a danger against which we have been amply forewarned. Men of science in Huxley's generation urged the claims of education with an assurance which is rarely voiced to-day. If we ask why this is so, one reason is not far to seek. The old tradition which exacted several years of classical study as the price of scientific education had at least one advantage. At the end of it, scientific worker and statesman had a common realm of discourse. In modern practice there is a complete dichotomy between an education which gives the statesman no prescience of the technical forces shaping the society in which he lives, and one which stimulates in the scientific worker little interest in the social impact of his own activities.

That there exists substantial reason for dissatisfaction with the exploits of contemporary statesmanship most scientific workers realise, and far-sighted leaders of scientific work like Sir Frederick Gowland Hopkins and Sir John Orr already recognise how the work of the man of science must inevitably suffer if society fails to make use of it. Sir Josiah Stamp's recent assault on the technocrats, in his Norman Lockyer Lecture before the British Science Guild on "The Calculus of Plenty", emphasises the absence of a common vocabulary to make the reasons for alarm rationally articulate. For the economist as such, plenty has little meaning aside from making what use we do make of our present resources with what social machinery we take for granted. The plenty of the scientific worker is a thermodynamic reality which resides in the balance sheet of human effort expended in securing available sources of power which could be applied to the satisfaction of our common mammalian requirements, if their use were rationally planned. The economist takes it as an axiom that people choose different things and does not concern himself with the fact that they have many common needs. The man of science sees society as an association of individuals with many basic requirements; and, since people have no instinct to recognise minimal quantities of ascorbic acid in their diet, he cannot assume that people necessarily choose what is best for them without a science of human nature to enlighten their choice.

The disruptive movements which have overwhelmed Germany and Italy have been, first and foremost, youth movements. Some explain this as a symptom of large-scale unemployment. In part it may be. Still, it is important to remember that, under existing conditions, it is nobody's business to take stock of what resources for human welfare are made available by progressive scientific knowledge. Consequently youth has some excuse for feeling that intelligent leadership in social affairs is not likely to come from present political parties. The existing curriculum of humanistic studies does little to arrest the retreat from reason Social history is a pageant of political controversy in which matters of sentiment play a larger part

than matters of fact, or a sequence of commercial enterprises solely controlled by the incentive of profit. What the expansion of maritime enterprise in the sixteenth century owed to rapid advances in nautical astronomy does not enter the picture. That witch-burning ceased almost as soon as the discovery that air has weight scattered the salamanders of alchemy, is shown to be more than a mere coincidence by the noteworthy experiment which Gassendi induced Colbert to witness. For purposes of history, as it is now taught, the general enlightenment of mankind proceeds with no acknowledgment of its debt to advancing knowledge of Nature.

At the end of the Great War, there was an articulate recognition of the danger of leaving the administration of a great country in the hands of civil servants trained in the tradition which prompted Mr. Gladstone's familiar query to Faraday. Pressure of informed opinion succeeded in securing a pivotal concession, when 'Everyday Science' was introduced as a compulsory subject in examinations for higher administrative posts of the Civil Service. The recent decision of the Commissioners to eliminate it will have deplorable consequences. Of late years there has been an encouraging sign of progress in the teaching of school science with more emphasis on its humanistic content. Many textbooks recently published show that more emphasis on the place of science in the education of the average citizen does not necessarily entail diffuse and vague courses of study conferring no knowledge which can be tested by customary examination standards. While the authors of such books deserve our gratitude, there is still ample scope for improvement, which will come, if teachers of science in the universities can be encouraged to co-operate with teachers of science in the school. In particular, there is need for more *extensive* as opposed to intensive teaching of isolated branches. With careful planning, and an enlightened social objective, this is not incompatible with examinable knowledge suitable for pupils of average intelligence.

The existence of the Civil Service examination in 'Everyday Science' acted as a catalyst. While it remained, it provided a unique opportunity for canalising the need for such co-operation by creating a demand for science courses in the universities suitable to students with a humanistic training. A beginning had been made under great difficulties with little appreciation from those who had been nurtured in the older tradition. If scientific men do not corporately influence the Commission to revise its decision, they will have forfeited an opportunity as well as a principle.

The Examination of Examinations

An Examination of Examinations:
being a Summary of Investigations on the Comparison of Marks allotted to Examination Scripts by Independent Examiners and Boards of Examiners, together with a Section on a Viva Voce Examination. By Sir Philip Hartog and Dr. E. C. Rhodes. (International Institute Examinations Enquiry.) Pp. 81. (London: Macmillan and Co., Ltd., 1935.) 1*s*.

WHEN the late Prof. F. Y. Edgeworth made the startling discovery that twenty-eight experienced examiners could assign to the same piece of Latin prose marks varying from 45 to 100 per cent, he raised a doubt about the efficiency of public examinations which must have lingered ever since in the minds of persons concerned in their administration. No one questions that the major public examinations of Great Britain are conducted with scrupulous fairness, great pains being taken to secure by supervision and co-ordination of the examiners' work that the ultimate verdicts shall be as trustworthy as possible. The precautions worked out by Mr. David Mair when he was director of the Civil Service examinations are a noteworthy example of scientific efforts directed to this end; and the same thing may be said of the measures described by Dr. Crofts in his writings. Doubtless there are other authorities responsible for important examinations who approach the problems of administering them in the same scientific spirit; nevertheless, the results of inquiries which Prof. C. W. Valentine published in his book on the reliability of examinations showed only too clearly how doubtful an instrument for achieving its purpose an apparently well-administered examination may be.

The uneasiness stimulated by Prof. Valentine's book must be greatly increased by the pamphlet now written by Sir Philip Hartog and Dr. E. C.

Rhodes on behalf of the English Committee of the International Institute Examinations Enquiry. The committee, it should be understood, is a branch of a body enlisted under the auspices of the International Institute, Teachers College, Columbia University, and financed by the Carnegie Corporation and the Carnegie Foundation of New York. The object is an inquiry into the functions, methods of procedure and solid value of examinations in the more important countries of Europe and in the United States. The investigation is naturally taking different forms in the several countries, and in England has been devoted mainly, as the appearance of this pamphlet suggests, to "the examination of examinations" from the point of view of their efficiency. The chairman of the English committee is Sir Michael Sadler; Sir Philip Hartog is the director of the technical inquiries the committee has conducted, while Dr. Rhodes has served as the committee's statistical expert.

Several other publications have appeared or will appear under the authority of the Committee, but so far as the general public is concerned none is likely to excite so much interest as the present brief, cogent and admirably written memoir. It would be improper to regard it as an 'indictment' of our public examinations, if only because the inquiry it describes was facilitated, and indeed made possible, by the cordial co-operation of several important examination authorities, and by the willing collaboration of expert examiners who work for them. The validity of the results here set out depends, in short, largely upon the fact that the material investigated consisted entirely of scripts that had been written and assessed in connexion with some public examination of repute, and that the agents were experienced examiners working at a familiar task under conditions to which they are well accustomed.

These things premised, it must be admitted that the results of the inquiry establish beyond a doubt that chance plays a seriously large part in determining the verdicts passed upon candidates in examinations in which a student's career is very often determined by the kind of place he takes. One has always recognised the possibility that a question paper may or may not 'suit' a particular candidate. But what is now brought out is the degree to which the mark assigned by an examiner to a candidate's answers may depend not merely upon stable personal characteristics for which allowance could conceivably be made, but also upon tendencies which vary from time to time, and even upon such factors as his interest in the subject-matter of a particular question.

The examinations selected by the Committee for the purpose of the investigations were: (*a*) the 'school certificate' examinations taken in secondary schools by between 60,000 and 70,000 candidates every year; (*b*) the 'special place' examinations (taken by from 400,000 to 500,000 children annually, and of enormous social importance), by means of which children between the ages of ten and twelve years gain admittance from primary schools to central or secondary schools; (*c*) a college scholarship examination in English essay; (*d*) a university honours examination in mathematics; (*e*) a university honours examination in history.

Under heading (*a*) the plan adopted in investigating the marking of history and Latin was to select in one case 15 scripts, in the other case 15 couples of scripts, all of which had received the same 'middling' mark from the school certificate authorities concerned. In each case the scripts were re-marked in turn and independently by 15 examiners, who were asked to assign to them both numerical marks and also awards of failure, pass and credit. In the case of Latin the examiners were divided into two groups who, in accordance with their expressed preference, were guided in their detailed marking by schedules differing in a good many particulars, one of them containing a greater number of instructions to examiners than the other. As the outcome of this second examination, the fifteen history scripts originally considered to be of equal value received 43 different marks varying from 21 to 70 out of a maximum of 96. The fifteen couples of scripts in Latin received from the six examiners who worked under Scheme I, 24 different marks ranging from 28 to 55, and from their colleagues who used Scheme II, 28 marks ranging from 33 to 61. Even more striking, if not more significant, was the fact that when fourteen out of the original fifteen examiners marked the same fifteen history scripts after an interval of a year or more, not only did their numerical marks differ from those they had previously awarded (a difference of as many as 30 marks being made by one examiner), but the verdicts of failure, pass and credit were also varied in a very serious degree. On each occasion the examiners awarded a total of 210 verdicts to the fifteen candidates who had all originally received the same verdict (pass); and in 92 out of the 210 cases the verdict on the second occasion differed from the verdict delivered on the first.

The examinations of scripts in French and chemistry followed broadly the same lines with modifications, scripts of which the original marks corresponded to a normal frequency distribution being selected instead of scripts originally declared to be equal in value. In both subjects the same discrepancies in judgment on the part of the examiners came out. As a comparable investigation of school certificate English, the inquiry conducted on behalf of the Durham

University Examinations Board is quoted. It showed much the same discrepancies, the most serious from the point of view of the candidates being, once more, the lack of agreement among the examiners, not only about the mark deserved by a particular script but even about the verdict to be passed upon a candidate's performance. For example, out of 39 candidates awarded a failure mark by one or more examiners, 24 were awarded a credit, 8 special credit, and 3 distinction by one or more of their colleagues.

The scripts of 150 candidates in a 'special place' examination required more complex investigation, since they dealt with two subjects, English and arithmetic. The number made it possible for the committee to test divergent methods of marking; for example, the marking of English essays by general impression as distinguished from marking in accordance with a detailed schedule of items to be assessed. An unexpected result of these variations in method was the discovery—confirmed later when diverse methods of examining were applied in honours mathematics—that a detailed schedule, while it may bring about a certain degree of uniformity in the assessments of examiners, still leaves a dangerous amount of variation possible.

It is scarcely necessary to follow the Committee through its other investigations, the results of which confirm the conclusions already indicated. Another examination of a particularly interesting type must, however, be referred to: namely, the *viva voce* examination of 16 candidates of excellent academic standing, well recommended by their universities and attracted by a prize of £100. The object here was to make the examination conform as closely as possible with the *viva voce* examination of candidates for higher posts in the Home Civil Service, and the work was entrusted to two boards of distinguished and experienced men and women whose names are given. All 16 candidates were interviewed by the two boards. The members of each board were requested to assess independently upon a given scale a candidate's merits as revealed in the interview; and after interviewing him each board agreed upon a joint mark. While there was substantial agreement between the opinions of the members of the same board, the verdicts of the two boards differed in a quite remarkable degree. For example, the candidate who stood first in the estimation of Board I was placed thirteenth by Board II. As Sir Philip Hartog remarks, such glaring differences can only be accounted for by the luck of the interview. Board I happened to strike upon a subject which enabled the candidate to reveal his individuality, while Board II, although doing its utmost to explore the candidate's mind, did not happen to touch the revealing spring.

To the major section of the report which describes the investigations and their results is appended a briefer section dealing with the statistical aspect of the inquiry. Its purpose is to show how, from the verdicts given on a number of scripts by a number of examiners, one could determine: (*a*) the ideal mark which 'ought' to have been given to a script; and (*b*) a measure of the random variations in assessment to which a particular examiner is liable. The assumption made is that the mark actually given in a particular case differs from the ideal by a fixed amount characteristic of the examiner's general habit of marking, *plus* an independently varying amount dependent upon a characteristic distribution of random variations about his standard. A reassuring footnote on page 44 mentions a further difference between examiners: namely, a difference in the spread or standard deviation of the marks they would give in a particular examination even if their random variations could be eliminated. It is stated that the influence of these further differences has been estimated, and as far as the examinations considered in the pamphlet are concerned, has been found to be relatively slight. This conclusion may be true of examinations such as those for the school certificate, where definite levels of achievement with definite marks connected with them are familiar to the examiners. The reviewer's experience of one of the largest 'special place' examinations has, however, led him to attach much greater importance than the authors think should be given to differences in the standard deviations of examiners' marks. Setting this point aside, all that need be added is that it is shown how the standard deviation of each examiner's random marks can be calculated. It is then possible, on the principle that an examiner's 'weight' is inversely proportional to his liability to random variations, to obtain a simple ratio from which the ideal mark can be calculated.

It must not, however, be supposed that the method of calculation, interesting as it is, can be used to remove from the marks given in public examinations the serious element of doubt they at present contain; for it depends upon the assumption that a considerable number of examiners have marked each script independently under carefully prescribed rules, and that is a condition which no examining authority could afford to incorporate into its procedure.

The future publications announced by the committee include a treatise on the "Marks of Examiners" by the present authors, which will also contain a memorandum by Prof. Cyril Burt. Serious students of the subject will look forward to this work, which will presumably develop a good deal further the technical methods to which

reference has just been made. But it is not necessary to wait for the further publication before expressing the opinion that the Committee, by the well-conceived and carefully conducted researches described in this memoir, and Sir Philip Hartog and Dr. Rhodes by their lucid account of them, have conferred a very definite obligation upon the public.

The public may, however, ask—and not unreasonably—how the Committee would deal with the disquieting things which the inquiry has revealed. Would it end examinations, or mend them? And if it would mend them, then in what way? The Committee does not entirely ignore these questions, but it has not gone into them. It points out that the "new type" examinations are by their nature entirely free from the weaknesses of the ordinary type; nevertheless, it cannot bring itself to contemplate the abolition of the essay type of answer, which is the kind normally demanded of candidates in public examinations. If the latter attitude prevails—and it is supported in Great Britain by an enormous weight of tradition and prejudice—the problem of retaining the present mode of examinations while making them reliable assumes very great importance. In view of its difficulty—perhaps its final insolubility—it would seem desirable to explore simultaneously alternative methods of assessing progress and knowledge at least for pupils at school. Attention should therefore, we think, be given to carefully standardised methods of recording progress such as those now used by some of the county authorities in their primary schools and described in the 1935 issue of the "Year-Book of Education".

Dreams and Culture

The Dream in Primitive Cultures

By Dr. Jackson Steward Lincoln. Pp. xiii+359. (London: The Cresset Press, Ltd., 1935.) 18*s*. net.

AMONG primitive and superstitious people throughout the world, dreams have nearly always been estimated highly. It was perhaps inevitable that western science, in its endeavour to eschew fantasy and concentrate on verifiable fact, should have reversed the verdict and regarded the unruly figments of our sleeping minds with ill-disguised contempt. Nevertheless, the mere occurrence of dreaming remained a challenge to the psychologist, while the high value placed on dreams by primitives is in turn a fact which can be neglected by the anthropologist only at his own peril. It is true that Tylor had already attributed a very important role to dreams in his doctrine of animism. Nevertheless, the rehabilitation of dreams by Freud should have implied as a practical corollary a thorough reconsideration, in the light of new knowledge afforded by psycho-analysis, of the influence of dreams on primitive culture, and it is perhaps indicative of the over-departmentalisation of the human sciences that it is only now, thirty-five years after the publication of the "Traumdeutung", that there has appeared a serious attempt at a general treatment of this subject.

It has often been noticed that the savage, like the child, appears to distinguish less easily than we do between dream events and events in waking life. This apparent confusion is due, Dr. Lincoln argues in this book, not so much to a real inability to separate the two types of experience, but rather to the fact that dream experiences are given an equal, or even a higher, reality value; and are not, as with ourselves, considered to be meaningless or negligible. Thus, to take an example quoted from Raymond Firth, an Indian dreamt that W. B. Grubb had stolen things from his garden and after waking demanded that he should make amends. Argument showed that the dreamer realised that Grubb had not been there in person. Nevertheless, he maintained, "If you had been there, you would have taken them". Here (in virtue of the psychological mechanism of projection) "the dream is given reality value at the expense of actual experience, yet there is no confusion between the two kinds of experience" (p. 29).

Furthermore, there would seem to be two distinguishable attitudes towards dreams among primitive peoples. In some cultures, as among the extinct Huron and the Navajo, the manifest content is taken at its face value, while in others, as among the Ashanti and the Naga, there is a search for latent symbolic meanings which, when found, enable the dream to be interpreted. To judge from the examples given, however, some degree of interpretation at least seems to be very general.

Perhaps the most important distinction made in the book is that between unsought, spontaneous, individual, dreams on one hand, and induced, 'traditional', 'culture pattern' dreams upon the other. The system of seeking guidance in dreams induced by some special ritual is very widespread. Temple incubation was fashionable in classical times, while in existing or recent cultures procedures for inducing dreams are found in Australia,

Melanesia, Polynesia, Africa and, above all, in North America, where the author's own field work was carried out. Here, as among the Crow Indians, the vision quest may even be "the most important social event in tribal life". Many examples, both from Dr. Lincoln's own extensive collection and from the records of other workers, show the paramount influence of these sought dreams upon the whole subsequent life of the dreamer. They may dictate his name, his profession (especially if he is to be considered as endowed with magical or healing powers), his guardian spirit, his courtship, his prayers and sacrifices, his treatment in mental or physical disease, or even in a social sense his sex, for certain dreams may compel a man to adopt the clothes and duties of a woman.

Not only the life of the individual but also that of a whole society may be profoundly affected by dreams, sought or unsought: war, myths, traditional dances, totems, religious ceremonies and migrations, being sometimes thus determined.

So important is the right dream vision that dreams may sometimes be purchased, though often this process is considered as dangerous to the vendor and therefore tends to be concealed. A stickler for accuracy of psychological description might suggest that this tendency to concealment renders it probable that actual individual dreams of a culture pattern kind are rarer than is commonly asserted. This, however, makes little difference to the sociological importance of the dream in general.

In most induced dreams of cultural importance, the new item of culture is nearly always prescribed by a spirit figure, which, Dr. Lincoln maintains, can be regarded as a father-imago in the psycho-analytic sense—and this irrespective of whether the dreamer belongs to a patrilineal or matrilineal society. Evidence is presented to show that the prescribed item represents an attempt to surmount the difficulties of the Oedipus complex, which thus, as psycho-analysts have already maintained from a different angle, is a very potent factor in moulding culture generally. This suggestion opens up an interesting problem (not here dealt with) as to the relation between culture pattern dreams and initiation ceremonies, in which culture items are definitely handed down by direct instruction from the elders.

Furthermore, it is maintained that the widespread occurrence of dreams of this description shows the ever-present nature of the Oedipus complex, which appears to recur spontaneously in each succeeding generation. If this is so, we can accept Freud's explanation of many cultural institutions without "fruitless speculations as to first origins" or the assumption of innate ideas or racial memories.

Dr. Lincoln's book (which contains a preface by Prof. C. G. Seligman) undoubtedly deserves careful consideration by students of both anthropology and psychology, and is a happy example of fruitful fusion of these two disciplines.

The Boundaries of the Sciences

(1) A Comprehensive Treatise on Engineering Geology
By Dr. Cyril S. Fox. Pp. xv+392+18 plates. (London: The Technical Press, Ltd., 1935.) 35*s*. net.

(2) Géologie appliquée
Par Prof. E. Raguin. Pp. 403. (Paris: Masson et Cie, 1934.) 38 francs.

(3) Useful Aspects of Geology:
an Introduction to Geological Science for Engineers, Mining Men, Prospectors and all interested in the Mineral Industries. By Dr. S. J. Shand. Second edition, revised and amplified. Pp. x+183. (London: Thomas Murby and Co., 1934.) 6*s*. net.

WATERTIGHT compartments are obsolescent in modern scientific thought, so that an increasing number of partnerships are found as in biochemistry, biophysics, the use of X-rays in medicine, crystal structure and industry, and the application of physical chemistry to road and building problems. The dangers of the over-specialisation of the scientific worker, so often debated and deplored in the columns of NATURE, have been much to the fore in recent years; and the reviewer well remembers a remark made in his student days by the then Provost of University College, London, to a gathering of undergraduates, in which it was pointed out that the difficulties experienced by graduates in finding employment was largely caused by the fact that they had specialised in one branch of science only.

The applied science known under the broad term of engineering has suffered less from this disability than many of the pure sciences such as geology, which apart from its application to mining is still regarded by many as an excellent hobby study, but as otherwise of limited practical application. Chemistry has extended enormously into almost all branches of industry, physics is rapidly following suit, while botany and zoology

are also finding applications in agricultural, horticultural, animal and fishery problems.

There are, however, signs that geology is beginning to realise its potential value for the civil engineer and roadmaker; and though much work both of an educational and of a research character still remains to be done before its application can be said to have been thoroughly explored, the small but persistent stream of scientific works is encouraging.

(1) The extremely readable treatise by Dr. Cyril Fox opens with theoretical considerations on such matters as the solar system and the age of the earth; and these topics, from their purely scientific interest, might have been abbreviated or omitted with advantage, while the next chapter, which deals with the common rock-forming minerals, contains matter irrelevant to the main theme. It is thought that a series of carefully selected photomicrographs, on the lines of those given by H. G. Smith in "Minerals and the Microscope", accompanied by really full descriptions, would enhance greatly the value of the work. The physical characters of rocks and minerals, as affecting their industrial and commercial uses, have been the subject of research in Germany, the United States and Great Britain during the past twenty years, but the treatise takes little account of any such developments published since 1925, and the usefulness of Part 1 (Building Materials) is curtailed accordingly.

The full treatment accorded to such subjects as isostasy and earthquakes is doubtless due to the experiences of the author in so unstable a region of the earth's crust as the Himalayas, and forms the basis of much of Part 2 (Field Operations); and almost the only valid criticism of this portion is in respect of the omission of any reference to recent studies by civil engineers of the behaviour of shingle beaches as agents of coast erosion. Part 3 deals with water supply, and it may be questioned whether an engineer requiring information on the quality of water would make reference to a work of this kind, which omits to discuss recent work such as chlorination of drinking water obtained from rivers, while yet dealing with the general considerations affecting rainfall and the movements of terrestrial waters in an orthodox but attractive manner.

The question of the matter to be included in or excluded from such a treatise must always be difficult, and the points mentioned above do not detract seriously from its value for any but the specialist reader. Such spelling errors as occur are probably due to difficulties of proof reading as between an author resident in India and his publisher in London; the style and method of publication are excellent.

(2) M. Raguin covers an even wider field, his first four chapters dealing with the evolution of the surface features of the earth, the mode of formation of solid rocks, the sequence of geological events and the nature of tectonic movements, while the succeeding nine chapters embrace such diverse matters as a brief outline of stratigraphical geology, materials of construction, the building of tunnels and barrages, the movement of underground waters, the combustible minerals such as coal and oil, the study of mineral veins and geophysical methods applied to prospecting.

Here again a readable style is combined with a series of very clear and evidently carefully prepared diagrams, the chapter on stratigraphical geology being interleaved with a series of photographs of common fossils characteristic of the various geological systems. One would perhaps have preferred to have seen a curtailment of this latter treatment, together with an expansion of the portions dealing with mineralogy and petrology, as likely to be of greater use to the majority of readers. The geological bias of the book is more apparent than in that by Dr. Fox, while the space accorded to such matters as overthrusting, klippen-structures and nappes, with all their complications, is only to be expected, having regard to the natural interest of French geologists in Alpine tectonics.

It is stated in the preface that the work is not intended for the specialist, but in spite of this proviso, it should prove of interest to many specialists requiring information on branches of the subject which are cognate to their own.

(3) As a purely introductory type of book, that by Prof. Shand is a most helpful work. It is many years since the elements of geological science have been set out in a manner so calculated to catch and to hold the interest of the non-technical reader. It is well known that one of the chief difficulties in this connexion is the avoidance of the use of scientific terms which are unfamiliar to the beginner, and Prof. Shand has succeeded admirably in his difficult task in this little volume. It is certain that geologists in Great Britain, often notoriously backward in attempting to popularise or to apply their science to the needs of the common man, will find it extremely difficult to cover so many really useful aspects of geology in so lucid a manner.

Emphasis is laid rightly on the importance of field and laboratory studies, and it would be an invidious task to point out minor omissions in a work covering so wide a field. It is to be hoped that the popular view of geology as a dry-as-dust subject will be still further dispelled by the appearance and wide use of still more books of the kinds noted above. B. H. KNIGHT.

Practical Quantum Mechanics

Introduction to Quantum Mechanics: with Applications to Chemistry
By Prof. Linus Pauling and Dr. E. Bright Wilson, Jr. Pp. xiii+468. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

QUITE a number of books have been written on quantum mechanics with applications to problems of physics. Now, however, we have something new, a book on quantum mechanics with applications to chemistry. It is a field which for some time has needed ploughing; and the names of the authors guarantee that the job has been well done.

The logical development of the book is extremely good. After the usual introduction and decline and fall of the old quantum theory, it proceeds to show how the Schrödinger equation can be set up for a system of interacting particles. The rigorous solutions for the harmonic oscillator, the hydrogen atom, and the particle in the box are then worked out in considerable detail. By this time the reader is well prepared for solutions by approximations; and perturbation theory and variation methods follow quite naturally. So far, only one-electron systems have been discussed, and as an introduction to many-electron systems a whole chapter is devoted to the helium atom, mainly with the view of accustoming the reader to spin, Pauli principle and all the other jargon of atomic and molecular structure. The discussion of atoms is rounded off with a difficult chapter on Slater's theory of complex spectra and Hartree's method of the self-consistent field.

About half the book has now been covered. The remainder deals chiefly with molecules, beginning with the rotations and vibrations of diatomic and polyatomic molecules, together with a short account of the selection rules. Then comes a section on calculations of the energy of formation of molecules. Simplest is the hydrogen molecular ion, and next the hydrogen molecule. This section ends with a brief description of Slater's treatment of polyatomic molecules and a few pages on 'resonance'.

At this point the authors, seeing that they are far from home in spite of nearly 400 pages, decide that the pace must be quickened. They select four applications of quantum mechanics to miscellaneous problems and write a few cogent pages on each, bundling them together to make the penultimate chapter. The last chapter is on the same plan, but takes as its subject matter some of the more important methods and principles of general theory. There is an appendix which includes many useful facts, such as physical constants and normalising factors, and this concludes with a fitting tribute to the Greeks in the form of the Greek alphabet!

The book is primarily an introduction to quantum mechanics, and as such necessarily contains a fair amount of material already available elsewhere. For example, the theory of the harmonic oscillator and of the hydrogen atom have already been given in many other places. Perhaps for this very reason they are now dealt with at unusual length. Numerous diagrams are given of the wave functions, and with their help the reader should readily grasp the significance of what might otherwise have remained merely a mathematical formula.

The book is highly recommended as a textbook of practical quantum mechanics. It is well balanced and very readable; the diagrams are workmanlike and the index good. Each chapter includes about half a dozen problems, and many suggestions are made for further reading. Unfortunately the book, like many others from the United States, is rather expensive. W. G. P.

Physics for College Students: an Introduction to the Study of the Physical Sciences.
By Prof. A. A. Knowlton. Second edition. Pp. xxi+623. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

THE author is to be congratulated on the production of an original and stimulating work which amply justifies the study of physics as a cultural subject. The treatment is based on the doctrine of energy, and, while it is quite elementary, making very little appeal to mathematics, it is closely reasoned, alive and in touch with reality, and calculated to keep the reader's mind constantly on the stretch. The fifty-seven chapters into which the book is divided cover very thoroughly the whole field of elementary physics, and at every step of his progress the reader may test his knowledge by means of well-selected quantitative examples and ingeniously devised topics for discussion.

A notable addition to the elementary literature of the subject. A. F.

Aufbau der zusammenhängenden Materie
Redigiert von A. Smekal. Pp. xiv+1203. ("Handbuch der Physik". Herausgegeben von H. Geiger und Karl Scheel. Zweite Auflage. Bd. 24, Teil 2.) (Berlin: Julius Springer, 1933.) 129 gold marks.

ONE hundred and twenty-nine gold marks may seem a very stiff price to pay for a scientific book even when advantage may be taken of the new facilities for purchasing German books at 25 per cent discount, but the present volume is exceptional in many ways. It contains some 1200 pages of excellently printed matter, and the subjects treated are such that it could not well have been inexpensively produced. It is well supplied with tables and diagrams, and little or no attempt has been made to save expense by undue curtailment of the mathematical treatment. One may legitimately look at the six chapters and ask oneself, in considering the cost, how much one would expect to pay for the excellent 300 page treatise on the electron theory of metals by Sommerfeld and Bethe, if it were issued in separate covers; or, again, what would be the market price of a book of 200 pages on atomic structure and chemistry, by Grimm and Wolff.

The plan followed is very satisfactory. Herzfeld writes on the size and structure of molecules, considers their electric properties, their band spectra and the forces between them in the various states of aggregation. Perhaps one may say that English readers will be surprised that he does not devote more space to viscosity formulæ in his comprehensive survey. Kronig deals with the relations between molecular attractions and the structure of crystals, and includes a neat account of the significance of the fine structure observed in the edges of X-ray absorption bands. Then follows the compact treatment of the electron theory of metals given by Sommerfeld and Bethe; it is doubtful whether some of the properties of metals here discussed have previously been described in so clear and concise a manner. The problems of the crystal lattice are examined by Born and Göppert-Mayer, Smekal deals with the factors which influence the properties of crystals, and the article by Grimm and Wolff completes the book.

It is an important contribution to the literature of modern physics and chemistry, and a work which will frequently be consulted by most research workers interested in modern theory. From this point of view it is a pity that the book is not issued in two or more separate parts. L. F. B.

Leçons d'algèbre et de géométrie à l'usage des étudiants des Facultés des Sciences
Par Prof. René Garnier. D'Après la rédaction de Badrig Guèndjian. Tome 1: Algèbre linéaire, homographie, équations tangentielles. Pp. viii+233. (Cours de la Faculté des Sciences de Paris.) (Paris: Gauthier-Villars, 1935.) 40 francs.

THIS book has been specially written by Prof. Garnier for mathematical students taking a course in the faculty of science at Paris. It is essentially a theoretical treatise embracing four chapters on linear algebra; two on the classic theorems of both plane and solid projective geometry and one on tangential equations. The treatment is wholly analytical and, as the author points out in the preface, the most general methods have been applied in establishing the fundamental propositions. Centres and diameters of conics, for example, are derived as special cases of poles and polars.

The text has been very clearly written, and it is difficult to discriminate between the excellence of the various chapters. Special mention, however, should be made of the brilliant analytical discussions on enharmonic ratios and envelopes. These, in spite of their generality, should not fail to stimulate a keen interest in the reader. If the book has a defect at all, it is that common to most French textbooks, for there are no exercises provided for the student's practice.

Toxikologische Mikroanalyse:
Qualitative Mikrochemie der Gifte u.a. gerichtlich-chemisch wichtiger Stoffe. Von Prof. Dr. L. Rosenthaler. Pp. viii+368. (Berlin: Gebrüder Borntraeger, 1935.) 25.50 gold marks.

THIS work may be regarded to a large extent as complementary to Dr. Rosenthaler's "Der Nachweis organischer Verbindungen" (Stuttgart, 1923), in which he treats of macro-analytical methods in organic chemistry. In the new volume he gives a comprehensive and reliable account of the many micro-methods which are now available for the detection of poisons, whether in traces or otherwise. As he points out, forensic chemistry offers a particularly favourable field for the application of micro-analytical methods.

The book gives a short general account (19 pp.) of micro-methods for sublimation, distillation, electro-analysis, spectro-analysis, crystallisation, etc., followed by descriptions of diagnostic tests for specific inorganic (76 pp.) and organic (259 pp.) substances.

The book is well printed, and there are numerous illustrations, chiefly of crystalline derivatives prepared in the various tests; it should prove of use to practical workers in forensic medicine and analytical chemistry in general. J. R.

Value and Existence
By Prof. N. O. Lossky and Prof. John S. Marshall, Pp. 223. (London: George Allen and Unwin, Ltd., 1935.) 7*s*. 6*d*. net.

AT a time when materialism appears to be at a discount, it is natural that discussions on the problem of values become more and more pressing. To such discussions, Prof. Lossky contributes an excellent monograph in which the notions of value and existence are interpreted in terms of a Neo-Platonism tempered by Christian ideals. Where true absolute concrete consubstantiality lies and how it is related to this world, are the two aspects of the problem dealt with in part 1 of the book. In the second part, which is contributed by Prof. Marshall, we find an explanation of some basic conceptions of Prof. Lossky's views. T. G.

The Phenomena of Spin in Detonation

CAMPBELL and Woodhead[1] discovered that in certain gaseous mixtures, when a detonating type of combustion flashed along a cylindrical tube, the flame front was not simply a disc-like or convex surface, but the detonation spun spiralwise along the tube, giving rise to a banded appearance in the photographs of the luminous products of combustion. Bone and Fraser[2] made a careful photographic investigation of the phenomenon, which showed that the initiation of detonation was almost

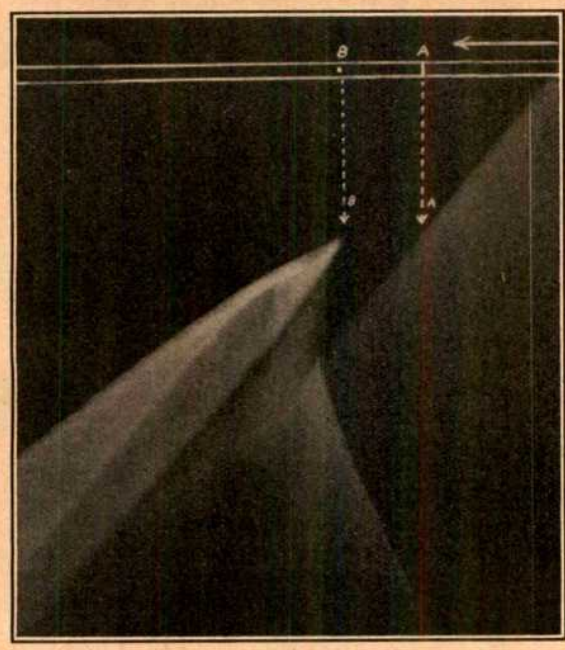

FIG. 1.

invariably associated with the spin of the 'head' of detonation but that in hydrogen mixtures it rapidly disappeared, whereas in certain mixtures it was visible in the ordinary flame before the detonating condition had been reached. They came to the conclusion that the frequency of the spin was fairly independent of the composition of the mixture, of its density and of the speed with which the detonation passed down the tube, but that it depended on the tube diameter such that the pitch of the rotation of the 'head' was about three times the tube diameter. Those results were obtained using a 9 in. duralumin drum rotating at 16,000 r.p.m. (equivalent to a film speed of 190 m./sec.). The extension of that investigation[3], which will be briefly described in this article, has been rendered possible by the use of a special camera whereby photographs could be taken at speeds which would be equivalent to using a film rotating on a drum at 1,000 metres a second, thus enabling events to be recorded which happen during a millionth of a second.

The apparatus consists essentially of a double-sided stainless steel mirror which is rotated at high speed, and flashes the image of the explosion formed by a suitable lens (Dallmeyer Pentac 12 in. focus) on to the surface of a circularly disposed stationary photographic film. In order to rotate the mirror at the high speed (30,000 r.p.m.), which is equivalent to a speed of rotation of the image of 1,000 per sec., the mounting has to be such that a vacuum can be maintained within the camera. The drive is by means of a 4 h.p. motor which can be maintained at any constant speed up to 6,000 r.p.m. by an auxiliary dynamo, the voltage output of which is controlled by altering the resistance in the shunt-field circuit; this, together with the friction drive off a spherical steel surface which is rotated by the motor, enables the most suitable speed to be chosen so as to provide the most accurate measurement of the flame. The explosive mixture is usually fired by a spark and travels down a 7 metre length of copper tube and then through a special tap into a glass tube 1·3 cm. diameter and $1\frac{1}{2}$ metres long which is placed in the field of view of the camera lens. Most of the experiments were made with $2CO + O_2$ mixtures.

It is only possible here to mention a few of the results of the investigation; the photographs provide detail of the phenomena of detonation never before attained. It has often been noticed[4], when the detonating type of combustion is initiated, that where this initiation occurs is somewhat ahead of the advancing flame front. The present investigation shows quite definitely that this is generally the case. The composite character of the setting up of the detonation is clearly shown in Fig. 1. The flame travels forward at 1,275 m./sec.; it so influences the combustible molecules in a compression wave ahead that ignition suddenly occurs at B, 6·3 cm. from the flame, which has reached position A, and from the position B a detonation wave travels forward at 3,260 m./sec. The velocity of this wave soon subsides, however, to 1,980 m./sec. A wave also starts in the backward direction from the seat of detonation through the gases with a resultant forward velocity of 350 m./sec., and gives rise on meeting the advancing flame to the 'retonation' wave travelling back through the products at 875 m./sec. Not only

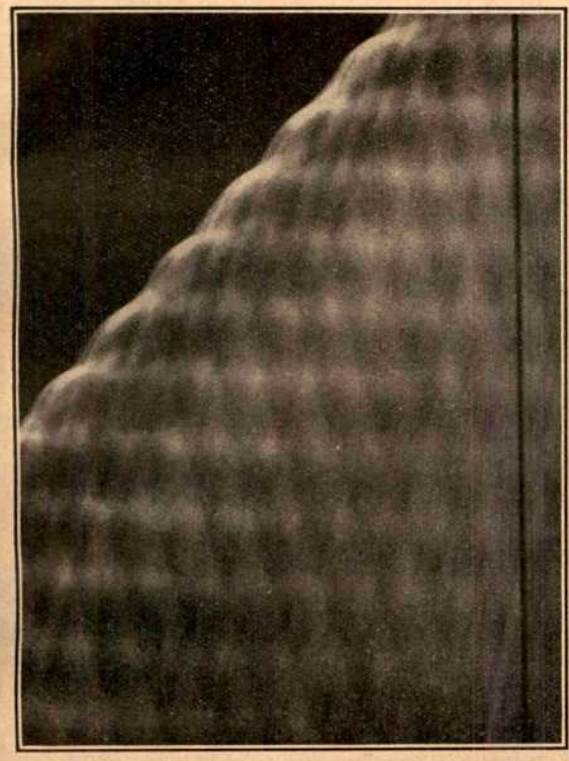

FIG. 2.

is a compression wave visible which travels out from the point of auto-ignition at 1,320 m./sec., but also, at the point where the initial rapid detonation in the forward direction subsides to the more normal velocity, a compression wave is visible which moves forward, also at 1,320 m./sec. The spin first makes its appearance at this point. The whole interval from the point when auto-ignition occurs to the point when the velocity subsides to 1,980 m./sec. is only about a ten thousandth of a second.

The spin is due to the spiral motion of the head of detonation down the tube, and the pitch appears to be governed mainly by the diameter of the tube, as was shown by causing a detonation to proceed down a tapered tube. It is possible to observe the phenomenon of spin and to maintain detonation in $2CO + O_2$ mixtures in tubes so small as 3·6 mm. diameter. In tubes of triangular or square section the pitch of the spin is nearly that which would occur in a tube of circular section of equal periphery; in a tube of oblong section the track is that in a tube of circular section the periphery of which corresponds to the shorter sides of the oblong.

The banded appearance of the after-flame which was obtained in former investigations is now shown by the higher resolution to be due to the criss-crossing of a set of waves or regions of high luminosity starting out from the spinning head twice during each rotation and proceeding at an angle of 22° to each other, one in the forward direction and the other slightly retrogressive (see Fig. 2).

The authors state that "whether or not a persistent spin develops in a detonation seems to depend on the requisite degree of excitation of the combustible gas. In cases (such as when hydrogen is involved) where this is easily attained, the initial close association between the forward moving compression wave and the burning medium in the front does not become attenuated and no persistent spin can be developed. On the other hand, a persistent spin develops whenever the requisite degree of excitation of the molecules of the combustible gas is such as to render the association between the forward moving front precarious so that an attenuated (cone-shaped) front develops". They also state that "it follows geometrically that at each half-rotation of the head a pocket of the unburnt gas will be enclosed on

FIG. 3.

three sides by the flame and thereby spontaneously ignited by its radiation", giving rise to the effects observed which accompany the spin.

The view that activated combustion must be associated with the compression wave in order to maintain detonation is supported by experiments in which a small ¼-in. nitrogen gap (obtained by means of the special tap) in the column of explosive gas causes the detonation and spin to be destroyed and only reinitiated when the flame front again catches up the compression wave. It is interesting to learn that, contrary to Dixon's results, the velocity and stability of the detonation wave is enhanced rather than diminished by intensively drying the carbon monoxide mixtures. Addition of hydrogen appears to give rise to a multiplicity of spinning heads, and more than 2 per cent of hydrogen tends to prevent the spin, though detonation is maintained.

The remainder of the present memoir relates to experiments on the effect of magnetic and electric fields on the propagation of detonation. Very strong magnetic fields were obtained by magnets of special design. A transverse field of 35,000 gauss had no appreciable effect on the detonation owing to the short time (0·005 sec.) the flame is within the field, but longitudinal fields of 22,000 gauss over a length of 58 cm., or of 35,000 gauss over 8 cm., caused an appreciable slowing down of the rate of travel of the detonation by about 50 m./sec. The effects of the magnetic field were not large. Strong electric fields (up to 5,000 volts per cm.), on the other hand, had a very marked effect, particularly when the flame travelled in the direction negative to positive potential; for example, when the detonation passed the negative electrode, both spin and detonation were suppressed, the flame speed decreasing to about 1,000 m./sec. by the time the positive electrode was reached and continuing to fall as it proceeded into the no-field region (see Fig. 3). For passage in the direction positive to negative there was a slight acceleration of the flame.

It is supposed that the positive CO^+ ions are important for the maintenance of activation in the detonation head, and that if these are drawn out of the flame front, the activation is not maintained and so the spin and eventually the detonation are destroyed by separating the region of activation from that of the region of high compression. This is borne out by the fact that in dry carbon monoxide mixtures or when hydrogen (0·3 per cent) is present, the 'damping' influence of the field on the detonation is counteracted. In methane mixtures, too, the spin and velocity were not influenced by the field.

There can be no doubt that these experiments form a highly interesting addition to information about the behaviour of the detonating type of explosive in gaseous mixtures. A. C. E.

[1] *J. Chem. Soc.*, 3010; 1926.
[2] *Phil. Trans.*, A, **230**, 363; 1932.
[3] Bone, Fraser and Wheeler, *Phil. Trans.*, *A*, **235**, 29; 1935.
[4] Le Chatelier, *C.R.*, **130**, 1756; 1900. Egerton and Gates, *Proc. Roy. Soc.*, *A*, **114**, 137; 1927. Bone and Fraser, loc. cit.

A Century of Botany*

1835—1885—1935

By Prof. F. O. Bower, F.R.S.

UP to 1885, the whole field of botany was supposed to be covered by the professor himself. The elementary teaching might embrace the spirit of all its branches: but the science as a whole was then like a bomb with its pin drawn out, ready to burst into divergent lines for which neither personnel nor accommodation were prepared. Stimulating the time surely was, but exacting to the point of impossibility. The best course for the new professor in Glasgow was then to select some branch as his own special study, and by preference one cognate with local history. Personal experience gained elsewhere pointed to the mosses and ferns, a line of specialisation which would renew continuity with the Hookerian tradition. Moreover, the overcast skies of Glasgow gave conditions suitable for their culture. So after an interval of half a century, the special line of research followed there by Sir William Hooker was resumed.

With the new ordinances framed under the Act of 1889 came changes of organisation, which had the effect of levelling up the Scottish university system to that of England. The establishment of degrees in science stimulated higher courses in all the departments, and this led, of necessity, to their expansion both in staff and in equipment. Under the new ordinances, the differentiation of elementary and advanced classes involved an

* *Continued from p.* 941.

increased staff. The appointment of additional lecturers and assistants stimulated research, for which space was now available.

A group of botanical investigators was thus formed, who not only pursued the special study of the living Archegoniatæ, but also extended their comparisons to the cognate fossils. The co-operation of Lang and Gwynne-Vaughan with myself established that 'triumvirate', who worked happily and fruitfully together for twelve years. In close relation with us that remarkable palæo-phytologist, the late Dr. Robert Kidston, a prince of amateurs, was also associated. With his aid new problems of comparison between past and present vegetation were opened. As results it may suffice to quote the series of memoirs by Kidston and Gwynne-Vaughan on the fossil Osmundaceæ, and those by Kidston and Lang on the fossils of the Rhynie Chert, carried out after Dr. Lang had moved to Manchester. These show the value of the co-operation between Dr. Kidston's house at Stirling and the Glasgow Department. Happily, under his will all the type specimens of these classic works, together with others of untold value, are now in safe keeping in the Department. Thus Glasgow became once more a centre for study of the Archegoniatæ. A ready channel of publication was offered by the Royal Society of Edinburgh. Its resources, with financial aid from the Carnegie Trust, have made a stream of published work available from the Glasgow Department which, in scientific value and beauty of production, will bear comparison with any produced elsewhere.

Passing now to the present time, we may ask how botanical organisation in 1935 strikes one who can compare it by personal contact with that of the previous century. As we have seen, up to 1885 each aspirant to a chair in botany was assumed to possess a general knowledge of and sympathy with all branches of his subject. These were themselves less differentiated than now, and some scarcely distinguishable unless as parts of a compact whole. Segregation followed quickly on the revival of the 'seventies and 'eighties. I well remember Sir Joseph Hooker saying ruefully to me in the early 'eighties, "You young men do not know your plants". That was at the time when systematic botany was beginning to lose its hold as the main staple in Britain. His judgment was true: we did not know them in the Hookerian sense.

A counterpart to Hooker's plaint may be found in the ironic hyperbole of a distinguished physiologist, who is reported to have said at a later date, "I suppose I do know half a dozen species of the British flora". These illustrations suggest the inevitable effect of that fission of a science which is apt to follow upon its detailed study. Hence as the years went on the position of the head of a botanical department, so often single-handed, became increasingly difficult. If he attempted to keep abreast of all branches he would become, like a medieval knight, overweighted by his armour of facts and theories, and ever less able to keep his place in the front line of research. Extinction as an effective unit would loom large.

From 1885 onwards there has been an increasing desire among young investigators to publish their results early. This offers promotion as its reward: for a published output of detailed research commonly weighs more with a selection committee than general knowledge, or the ability to administer and to teach. A premium is thus placed upon early specialisation, and the young aspirant is in danger of developing "like an ill-roasted egg, all on one side". Some great departments already have special sub-departments of pomology, of citrus fruits, or of bananas, to which specialists severally devote their lives. Among these various cults we may well ask, where do the major departments of morphology, physiology and classification come in? Doubtless each of the minor branches is in touch more or less directly with one or more of these foundations of the organised whole. But each may be pursued without any realisation of what that whole actually is.

A necessary corrective will be an avoidance of too early specialisation, and the cultivation of the type of mind that strikes a fair balance between the fundamental branches. This is indispensable above all for the administrative head, who is responsible for maintaining a balance between the various branches in the organisation of his department. There is no difficulty in finding among young graduates those able to carry out special inquiries of detail. What will be required more and more urgently as time goes on is the synthetic mind, that ranges over a wide field with adequate command of detail, and is able to compare, evaluate and deduce. This is essential for the all-round botanist, that less common type from which comes the successful head of a department. Risks of development await both types. The former may continue his analysis and never advance beyond providing recorded details for others to use. He may, however, develop powers of synthesis as he proceeds, and through successive steps of increasing constructive power attain some more responsible position. The risks of the naturally synthetic mind are different. If the young investigator is dexterous in presentment of his results, he may soon find himself advanced to a position of command. Then comes for him a testing time, when a decision must be taken whether administration or research shall dominate. The nature of his office will probably give

opportunity for both, and the precedence of one or other will be largely a matter of his own choice. At first the question rarely presents itself in an acute form. The cumulative effect of years often decides whether their victim shall quite unconsciously become part of an organising machine: or whether he shall continue to be a direct influence in creative science. Happy is the man who can do both.

It is not difficult to cite examples that illustrate these divergent results. In the lives of some of our greatest men the strangle-hold of administration has tended to choke the active spirit of personal observation. Among those who have passed away we may contrast the lives of Huxley and his friend Darwin. I well remember at South Kensington the glass jars holding material of the pearly nautilus which awaited the dissection that never found its place among Huxley's crowded hours of departmental committees and meetings of the Royal Society Council. On the other hand, Darwin, cloistered at Down, was free at a like age to continue his work on orchids and earthworms. Michael Foster and Thiselton-Dyer, who shared with Huxley the burden of the reorganisation of practical biology in the 'seventies, left little behind them as their published record beyond textbooks and official documents. Administration atrophied personal research in both of them. Even Bayley Balfour, who had shown his mettle as an investigator before he was thirty years old, spent his best period in ministering to the scientific wants of others: and only returned in his last years to the detailed systematic work in which he was a master. It is not for us to judge in such instances whether or not the results of administration have justified the sacrifice of personal opportunity for creative work. We are all debtors to these great men. But they are here cited as examples of a prevalent danger that grows more insistent as years advance. Administrative activity and continued personal research are conflicting factors in the individual life. The former has often become dominant even where the instinct of inquiry is strong.

Returning, in conclusion, to the intra-departmental aspect of this question, the most vital relation is between the professor and his students. How will his decision as to the balance between administration and research affect them? It may be urged, in support of giving priority to the former, that the smooth working of a well-organised department amply justifies the time and thought that it demands. The larger the department, the more pressing the demand will be: the students feel the result of good organisation, though few of them would analyse it back to the source. On the other hand, the effect of a prevailing atmosphere of research in a department is tonic and stimulating. It was the very essence of the Huxleyan revival that it converted every student into a potential investigator. The stimulus should emanate from the head of the department, passing either direct from him, or through lecturers and demonstrators to the individual student. But the method loses its point if the professor himself is in practice a mere administrator. Such chains of influence are felt rather than visualised; often the stimulus is almost unconsciously conveyed. An allusion in a lecture to experiences in the field, or an observation on material collected abroad, gathers up the attention of a class and makes it think more effectively than floods of fact at second hand.

A still more direct influence follows if a student penetrates with a question to the private room, and the professor rises from his microscope to reply; perhaps he may even allude to some observation that is interesting him at the moment. The student at once feels that he is in touch with the margins of knowledge. The opportunity for such touches is lost if the private room is a mere 'office'. I have found it sometimes known by that paralysing name. The undifferentiated private room, part laboratory part administrative centre, has qualities worth retaining not only for economy of space and time, but also in affording occasional completion of contact between the potential researcher and the professor actually at work.

Thus dangers lurk within the growing elaboration of a scientific department. Not the least of these will be to secure a due balance between administration and research in the person of its official head. Again I say, happy is the man who can hold the balance until strength itself fails. Among the distinguished graduates of Glasgow we possess two notable examples. Sir Joseph Hooker's youth was spent in acquiring experience and material; his middle age in working it up, in the intervals of administration as director of the Royal Gardens at Kew; in his old age he brought to completion systematic works of the greatest magnitude and value; but in the very last years of his long life we saw him still engaged in describing species new to science. On the other hand, Lord Kelvin continued the administration of his Department of Natural Philosophy for more than half a century; concurrently he carried on his own researches, and applied their results practically to the requirements of modern life. Until the day of his death he remained Chancellor of the University of Glasgow, and held the honourable title of a Research Student under Ordinance. Neither of these great men ever relaxed his hold upon personal observation. There is no stronger link than this between a professor and the real student.

Obituary

Prof. J. D. Cormack, C.B.E., C.M.G.

JOHN DEWAR CORMACK was born in 1870, a son of Alexander Cormack, rector of Dumbarton Academy. His career as an undergraduate at the University of Glasgow was a distinguished one, and those of his fellow students who are left still remember the successes and the prizes he gained at his class examinations.

In 1892, Cormack proceeded to Yorkshire College, Leeds, where he was appointed as lecturer in engineering subjects, specialising chiefly in electrical work. In 1896 he returned to Glasgow as assistant to the late Prof. Barr, and for some years acted as lecturer in electrical engineering. In 1901 he was appointed to the chair of mechanical engineering at University College, London, where he remained for twelve years. He took a prominent part in the affairs of the University of London and did conspicuous service on the engineering examining boards for both internal and external students.

In 1903, Cormack succeeded the late Prof. Barr as regius professor of civil engineering and mechanics at the University of Glasgow. He was welcomed back to his old college with enthusiasm, for his reputation as an exceptionally fine lecturer and teacher, as well as his prowess as a Rugby player and a golfer were well remembered. His appointment coincided with the affiliation to the University of the Royal Technical College, when much anxiety was felt over the possible troubles that might arise in the changes that would inevitably take place in the teaching and examination systems of both institutions. That the affiliation has been a great success was in a great measure due to the enthusiasm with which Prof. Cormack entered into the closer association of the two great engineering schools.

With the outbreak of war in 1914, Prof. Cormack gave up for the time his university work and placed his engineering knowledge at the disposal of the nation. His labours were largely in the aeronautical branch of war service. He occupied in succession the positions of chief contracts officer of military aeronautics, director of aircraft supply and equipment, and assistant controller of the aeronautical departments. From 1917 until 1919, he was in the United States as a member of the British Mission. In addition to the honours indicated by C.B.E., and C.M.G., he had the decoration of Chevalier of the Legion of Honour conferred upon him by the French Government; he was also an honorary brigadier general and honorary group captain R.A.F.

In 1932, Prof. Cormack was elected as president of the Institution of Engineers and Shipbuilders in Scotland, thus following in the footsteps of his famous predecessors in the engineering chair—Rankine, James Thomson, and Barr. His election indicated the esteem in which he was held by the Clydeside engineers and shipbuilders, and his term of office, which had only expired a few months before his death, will be long remembered for the quiet and efficient manner in which the business of both council and general meetings was conducted.

Prof. Cormack's death was sudden and unexpected. During the summer months he had been receiving medical attention, but he had taken up his university duties at the beginning of the session and was lecturing until a day or two before his death. A chill rapidly developed into pneumonia, and he died on Saturday, November 30.

As a professor of engineering Prof. Cormack was more attracted by teaching and administrative work than by experimental research. His students will long remember him for his lucid, well-delivered lectures as well as for the kindly interest he took in both their studies and college activities, and the efforts he made to start them in their engineering careers.

Dr. William MacDonald

THE death of Dr. W. MacDonald at the age of sixty years removes an enthusiast for South Africa and a firm believer in her future as the seat of a white civilisation. A Scotsman by birth and education, he spent some time studying in the United States and in France before settling in South Africa. There he realised that the prosperity produced by the recently discovered gold mines could only be stabilised by a concomitant development of agriculture, and he became the leading protagonist of his time for the dry-farming system. His two books—"Dry Farming" and "The Conquest of the Desert"—focused attention on what was, and probably always will be, one of the greatest obstacles to intensive agriculture in South Africa, and although modern policy is directed, perhaps wisely, towards encouraging extensive animal husbandry rather than the more intensive dry farming advocated by Dr. MacDonald, the influence of his work can be traced in the way that policy has developed. The growth of the citrus industry owes not a little to his encouragement in its early days. He had some of the enthusiasm of Cecil Rhodes for colonisation, and became director of the South African Land Settlement Bureau which did much to promote immigration before the Great War. He was proprietor, editor and a frequent contributor to the *Agricultural Journal of South Africa*, and was the prime mover in the institution of a faculty of agriculture at the University of Pretoria.

While MacDonald's life's work was in agriculture, he also took a deep interest in the mining industry, realising that this must be the real foundation on which a South African civilisation would be built. He is best known in England for his book "The Romance of the Rand" (1933), in which he gives a vivid account of the discovery of gold by his friend, Mr. F. Struben, and the early struggles of the pioneers.

News and Views

President Masaryk

IT was announced in Prague on December 14 that Prof. T. G. Masaryk, who has been president of the Czechoslovakian Republic since its foundation in 1918, has tendered his resignation. Prof. Masaryk was sixty-eight years of age when he returned to Prague at the end of the Great War and now, at the advanced age of eighty-five years, after guiding the destinies of the nation for seventeen years, he has expressed a wish to retire. Some time back he was taken ill with eye trouble and rheumatism, but he made a remarkable recovery and resumed duties and especially his reading of current scientific literature. During the Great War, Masaryk held a professorship at King's College, London, but his educational work receded as his powers as a statesman came to be recognised and utilised. His own efforts to secure the independence of Czechoslovakia were realised on October 28, 1918. Masaryk's long career has been a continual series of struggles in the interest of truth, both in science and in affairs. He began life as an apprentice to a locksmith but, through the efforts of his schoolmaster, continued his education at Brno Grammar School and the University of Vienna where, in 1878, he was awarded the Ph.D. degree.

MASARYK's first philosophical work was "Suicide as a Social Phenomenon of the Present Day" (1881) and it secured for him a Vienna lectureship. In the following year he obtained a professorship at Prague, where at first the 'lonely Slovak' did not make many friends, and his scepticism (justified as investigation proved) of the genuineness of some old Czech manuscripts brought him much abuse. From his philosophical studies he was led to the formation of a 'Realist' movement. "Realism," he declared, "is an attempt to popularise the whole realm of science and philosophy. Without distorting scientific exactitude, realism strives to render science accessible to every class of the people. It is a protest against the monopoly of learning, its endeavour is to socialise scientific and philosophical culture." He married a distinguished American, Miss Charlotte Garrigue, in 1878, incorporating her name with his own. She entered ardently into all Masaryk's work until her death in 1923. They paid several visits together to England, America and Russia, and his wife undoubtedly helped him in the compilation of his philosophical works, especially when he was editor of the scientific section of the Prague daily, *Národní Listy*. Just before the Great War he wrote "Russia and Europe", one of the most important books on the subject, showing as it did the true state of the great Slav country and the directions in which affairs were drifting. His post-War books include "The Making of a State" (1927) and "Les Problèmes de la Democratie" (1924). He was also instrumental in the establishment of the Masaryk Academy of Work, which is concerned with the fostering of research, especially in such branches of applied science as chemical technology. Many valuable original memoirs have been published through the help of this Academy.

Tercentenary of Champlain

ON December 25 the tercentenary occurs of the death of Samuel de Champlain, the French explorer who founded Quebec, and was the first governor of Canada. Born in 1567 at the village of Brouage in the ancient province of Saintonge, now the Department of Charente-Inférieure, he served in the wars of the League under Henry IV, but after a voyage to the West Indies, he was placed in charge of an expedition to continue the work of Jacques Cartier, the discoverer of the St. Lawrence. On May 24, 1603, Champlain anchored in that river, and for the next four years was engaged on exploring the Bay of Fundy and other parts. A visit to France was followed by another expedition, and in July 1608 he founded the settlement which he named Quebec. Thence he made a journey up the Richelieu, and discovered and explored the lake which bears his name. Other explorations took him to the western shores of Lake Huron and to Ottawa. Again in France in 1620, he returned with his family and with a commission as governor of the new settlement. About seven years later, owing to the outbreak of war between France and England, his supplies were cut off, and Quebec had to be surrendered. After the declaration of peace, however, in 1633, he was again able to return, and it was in Quebec that he died. He wrote accounts of his voyages, and these were republished in Quebec in 1870.

British Association: Officers for 1936

THE annual meeting of the British Association will be held next year in Blackpool on September 9–16 under the presidency of Sir Josiah Stamp. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Prof. A. Ferguson; B (Chemistry), Prof. J. C. Philip; C (Geology), Prof. H. L. Hawkins; D (Zoology), Dr. Julian Huxley; E (Geography), Brig. H. S. L. Winterbotham; F (Economic Science and Statistics), Dr. C. R. Fay; G (Engineering), Prof. W. Cramp; H (Anthropology), Miss D. A. E. Garrod; I (Physiology), Prof. R. J. S. McDowall; J (Psychology), Mr. A. W. Wolters; K (Botany), Mr. J. Ramsbottom; L (Educational Science), Sir Richard Livingstone; M (Agriculture), Prof. J. Hendrick. The president of the Conference of Delegates of Corresponding Societies will be Dr. A. B. Rendle.

Prehistoric Research in South Africa

IN another column of this issue of NATURE (see p. 998) we publish an announcement of action taken by the Government of the Union of South Africa which will play a part of great importance not only in the advancement of the study of the prehistory of the sub-continent, but also ultimately, it may be asserted with confidence, in the elucidation of the whole problem of the distribution and development in culture of early man. The joint geological and archæological survey of certain sections of the Vaal and Riet River valleys, for which arrangements are being made by the Directors of the Geological Survey and the Bureau of Archæology of the Union, will cover an area which in the view of local archæologists, and indeed, as has been shown notably and convincingly by the exploratory work of Prof. C. van Riet Lowe, is of cardinal importance in the correlation of geological and archæological data in South Africa and the determination of their relation to evidence of climatic variation. As the survey will occupy fully the services of two geologists and an archæologist for at least eight months, the undertaking will be costly; but the expenditure is justified, even in present financial conditions, by the fact that this key area will be inundated when the dams now in course of erection across these rivers have been completed.

THE study of the prehistory of South Africa has made great strides in an incredibly short time, thanks to the enthusiasm of local archæologists and the insight with which they have applied and adapted to local conditions the lessons of European archæology. When, however, the survey now initiated has been completed and its results, whatever they may be, have been made available for correlation with those of analogous studies in other parts of the world, where the records of pluviation and glaciation are being interpreted and brought into relation, the study of prehistory at large will be deeply indebted to the Government of the Union of South Africa for its public-spirited promotion of this investigation while opportunity still served, and to the South African Association for the Advancement of Science for its services to research in urging upon the Government the desirability of an undertaking which not only will promote understanding of the conditions of a problem of the first importance in human history, but also holds out every promise of being of crucial influence in the future of prehistoric studies.

Sign Language as a Form of Speech

IN his Friday evening discourse at the Royal Institution on December 13, Sir Richard Paget discussed "Sign Language as a Form of Speech". The clue to the relationship between bodily gestures and the gestures of the mouth which produce speech was given by Darwin in 1872—namely, in the sympathy of movement between man's hands and his mouth. Charles Dickens, thirty years earlier, in "Pickwick Papers", had noticed the same effect. The deaf mute sign language is natural and universal among deaf mutes of all countries. The Red Indians of North America had a similar language of signs by which they could all communicate. In 1929, William Tomkins published his "Universal Indian Sign Language", which described 700–800 signs. The sign language of the aborigines of North-West-Central Queensland was described by Walter E. Roth in 1897. Garrick Mallery, writing in 1881 on the Indian sign language, described also the sign language of the Neapolitans. He concludes that all these languages are only dialects of a single language—the gesture speech of mankind. Recently, the Russian Academy of Sciences has discovered a sign language, used by women only, in Russian Armenia—also a pictographic script, twelfth to seventeenth centuries, which in many instances illustrates the sign language. Mr. Ivan Sanderson has recently discovered a sign language in the Cameroons; but hitherto gesture languages have been largely ignored. Many people think any alteration of spoken language is sacrilege; actually, all spoken languages are still primitive and unsystematic. Sign language is capable of great development as a universal language. Abstract ideas can be expressed in signs exactly as in spoken language—namely, by metaphorical reference to concrete ideas. Signs—unlike words—can be quantitative as well as qualitative, and shapes can be signed by direct imitation. In experimenting with the development of a new sign language, the vocabulary has been based on C. K. Ogden's 'Basic English' (850 words), but a much shorter sign vocabulary will suffice.

Archæological Museums

THE problem of the preservation and proper display of archæological collections and the associated 'finds' from the excavation of archæological sites is discussed by the Editor of *Antiquity* in the December issue of that journal. Briefly stated, the points to which he directs attention are two: the restrictions of space which preclude display according to modern methods, and differentiation to meet the respective needs of the 'ordinary' man and the student; and secondly, the necessity of a better organisation and distribution of the archæological material available for exhibition. In connexion with the second point, he is clearly preoccupied with the position of the British Museum (Bloomsbury), and here, as he points out, the question of reorganisation and distribution involves legislation. Further comment on the allocation of space to archæological exhibits may perhaps be postponed, pending the publication of a promised article in *Antiquity* which will deal with museum buildings.

THESE questions, however, serve to remind us that there are other aspects of the museum problem, which inevitably must be discussed, if, and when, the organisation of collections and their exhibition come under consideration. How far will it be advantageous, for example, to attempt to define the function of the local (that is, locally owned or municipally owned) museums, or to draft some scheme of co-operation between them and the

national collections, which would serve as the basis for a national system, in which museums of general cultural and archæological interest dovetailed with a grouping of auxiliary museums of localised or specialised function. That there is already a certain amount of co-operation, localisation and specialisation in action is, of course, well known. The university museums, having special functions, would have a special place in such a scheme. There is at present, in fact, a certain amount of specialisation as between the museums of the various universities, the Pitt-Rivers at Oxford being the most conspicuous example. In one direction the way has been pointed out by Dr. R. E. Mortimer Wheeler, in his address when declaring open the Bishop Hooper's Lodging as a folk museum at Gloucester on October 10 last. A report of his address and of the opening ceremony will be found in the *Museums Journal* of December. Dr. Wheeler's most suggestive remark was that pending, or the pessimist might say failing, the institution of a national folk museum, the local museum should set about the collection of the material of local folk culture before it is too late.

English Instrument Making

At a meeting of the Newcomen Society held at the Science Museum on December 11, a paper by Dr. R. S. Clay and Mr. T. H. Court on "English Instrument Making in the 18th Century" was read. As is well known, Mr. Court has contributed largely to the collection of scientific instruments in the Museum. Some of these had been arranged on the lecture table, and during the reading of the paper Dr. Clay used them to illustrate his remarks. In the eighteenth century, he said, England was fortunate in having a number of men who were not merely instrument makers but also men of scientific knowledge. Moxon, Senex, Short, Dollond and Nairne were all fellows of the Royal Society, and they and others such as Benjamin Martin, George Adams and James Ferguson made advances in the construction of scientific instruments which placed English microscopes, telescopes, etc., in the forefront and caused them to be copied abroad. One important invention was that of Marshall, who introduced the method of grinding a large number of lenses together on a block with a spherical tool, another that of the method of drawing brass tubes on a steel mandrel by which tubes capable of sliding smoothly in one another for telescopes could be made. Cuff, it appears, first introduced an all-brass telescope as a commercial instrument. The invention of the achromatic lens by Dollond, the invention of the quadrant by Hadley, the improvement in dividing scales by Bird and Ramsden and the construction of reflecting telescopes by Short all contributed to the supremacy of the English instruments. The biographies of a few of the most famous instrument makers only are known. Short was one of the few who made money by his business; a good many others were at various times made bankrupt. The outstanding men at the end of the century were Jesse Ramsden (1735–1800) and Edward Nairne (1726–1806).

Dr. R. A. Millikan and the Earth's Magnetic Field

Ever since the time of Gauss, it has been assumed that the intensity of the earth's magnetic field is practically symmetrical. When attempting to find out the nature and distribution of the cosmic rays, Dr. Millikan has discovered that we must seriously modify our ideas about the earth's field. According to a report by Science Service, Washington, D.C., Dr. Millikan in a paper read at a meeting of the National Academy of Sciences at Charlottesville, Va., stated that the magnetic field extends into space for at least 10,000 miles and that the magnetic intensity is stronger on the side of the earth opposite to America. There is a greater effect on the cosmic ray intensity from the north magnetic pole to the equator in the region of India than there is in comparable latitudes in America. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has compared the magnetic variations on the surface of the earth with Millikan's results determined by cosmic ray intensities. It concludes that the variations of magnetism extend many thousands of miles into space. The earth's field appears to be lopsided.

A Standardisation of Inefficiency

In the *World Economic Survey* just issued by the League of Nations instructive statistics are given of the world production of electrical energy. Taking the average annual issue from 1925 until 1929 as 100, the issue in 1932 was 119, in 1933 it was 125 and in 1934 it was 138. Perusal of the *Survey* shows that in no other branch of industrial activity has such rapid progress been made during this period of great depression. *World Power* of October, in commenting on this, points out that the manufacture of plant does not increase *pari passu* with the demand for electrical energy. Part of the lag may be due to the great advances made in generating efficiency as a result of industrial research. This may have inspired a policy of caution among buyers of plant, and so they may be chary of placing new orders. It may be advisable to correlate technical research and new orders for electrical development, if overseas countries continue to protect inefficient installations by obsolete standardisation regulations. *World Power* states that scientific investigation is likely to receive a severe setback because research work will lack a world market for the products it improves. A secondary boom tends to develop in the sheltered manufacturing industries abroad, which receive added protection from the depreciation of the exchange. A number of foreign countries with depreciated exchanges are adopting plant and equipment regulations which give results much inferior to those obtained by research and the best technical practice. There is in fact a tendency towards standardising inefficiency, and this discourages scientific research.

Modern Physics

Of the series of pamphlets recently issued in Paris by Messrs. Hermann et Cie under the title "Actualités

Scientifiques et Industrielles", six deal with physical questions. M. Jean Perrin, under whose direction the pamphlets dealing with atomistics are issued, is himself responsible for four entitled "Grains de Matière et de Lumière". The first is on the existence of the 'grains', that is, of atoms, electrons and photons, the second on the structure of the atoms, the third on the complexity of their nuclei and on their radioactivity, and the fourth on the changes which can be produced in them by bombardment. Prof. Joffé of Leningrad, who is dealing with the physics of solids, contributes a somewhat longer pamphlet, on semiconductors, the conductivity of which is due to a small fraction only of the valence electrons attached to their atoms. M. Y. Rocard presents the first pamphlet of the series on hydrodynamics and acoustics, on the statistical theory of fluids and the equation of state, by M. J. Yvon. Each pamphlet gives a concise and readable account of the present state of the subject with which it deals, and is written by one who has himself made distinct and valuable contributions to our knowledge of it.

Radio Data

A SECOND edition of "Radio Data Charts" by Dr. R. T. Beatty (Iliffe and Sons, Ltd. 4*s*. 6*d*. net) is to be welcomed, since the opportunity has been taken to extend its scope to cover the most recent advances in radio technique. The various abacs provided now cover wave-lengths down to five metres, while provision is made for audio-frequencies over the range 20–10,000 cycles a second. This publication contains a series of thirty abacs with explanatory notes and examples, by means of which many of the quantities required in radio-frequency work can be obtained directly without the necessity for laborious calculation. In addition to the means for obtaining the inductance, capacitance and reactance of coils and condensers at both audio- and radio-frequencies, charts are given for obtaining the efficiency and time constant of a grid leak and condenser combination, for designing coils to have a minimum radio-frequency resistance and for the design of attenuation circuits, to select only a few typical examples. The whole series of charts is printed in a clear and easily accessible form and will be found to be most valuable to engineers, experimenters and students dealing with radio-frequency work.

Clough Memorial Research Fund for Geology

THROUGH the generosity of Mrs. Clough, a fund was established in 1935 in memory of her late husband Dr. C. T. Clough, for the purpose of encouraging geological research in Scotland and the north of England. The north of England is defined as comprising the counties of Northumberland, Cumberland, Westmorland, Durham and Yorkshire. Under the terms of administration of the fund a sum of approximately £30 will be available annually. Applications for grants for the period April 1, 1936–March 31, 1937 should state the nature of research to be undertaken, amount of grant desired, specific purpose for which the grant will be used and whether any other grant-in-aid has been obtained or applied for; they should be in the hands of the Secretary, Clough Memorial Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than February 1, 1936.

Statistics of the British Cinema Industry

AT the meeting of the Royal Statistical Society on December 17, Mr. S. Rowson read a paper entitled "A Statistical Survey of the Cinema Industry". When the figures disclose that in 1934 there were 957 million admission tickets sold for the sum of £40,950,000 (the average price of a ticket thus being 10·3*d*.), and when one further considers the character and splendour of the modern cinema together with the fact that four out of every five people visiting the cinema pay not more than one shilling for a ticket, the cinema is shown to be as one of the sociological wonders of the century, meriting attention and investigation. Of the year's revenue from admissions, the Government claimed £6,800,000 in entertainment duty. The average weekly cinema attendance throughout the year is about 18½ millions. At the end of 1934 there were 4,305 cinemas in Great Britain, with an average of 900 seats in each. In the London postal area alone, there were 401 cinemas. Of the various districts Lancashire had the greatest number with 699, Midlands next with 585, and Yorkshire and district next with 534. North Wales had the smallest number with 62—as opposed to 259 in South Wales. In the London area there was one seat for every 14 of the total population; in the Lancashire area one to nine; in the eastern counties one to nineteen; in South Wales one to ten. Eliminating the population under 15 as infrequent cinema-goers—the number of persons per seat were: in London, 10·9; in the Eastern Counties, 14; in the Midlands, 9·6; in Yorkshire, 8·0; in Lancashire, 7·0; and in South Wales, 7·6. It will be seen from the foregoing that the problem of redundancy or overbuilding is now becoming serious.

Food of the Bullfrog

MR. S. W. FROST had a bullfrog of 200 gm. under observation in a cage provided with a small pond ("The Food of *Rana catesbeiana*, Shaw", *Copeia*, No. 1; 1935). Its feeding capacity is amazing. During the summer it ate more than four hundred and twenty-seven grams of food—more than twice its own weight—in less than five months. The artificial conditions may, however, have caused it to eat more than it would have done in natural surroundings. The food eaten included 56 amphibians (frogs, toads and salamanders), 63 insects (beetles, moths, caterpillars, grasshoppers and cicadas), slugs (*Limax maximus*) and birds. As an example, on June 23 it ate 2 Promethia moths and 8 other insects; June 24, 1 Promethia moth, 3 other insects and 1 nestling sparrow (18 gm.); June 25, 1 frog (6 gm.); June 16, 2 frogs (13·5 gm.). It has a curious method of accepting its food, preferring to take it under water; "sometimes it snatches a morsel of food on the bank of a stream or pond, but invariably jumps into the water and submerges it to swallow".

Swimming Baths and Pools

THE Minister of Health has directed the attention of local authorities for the necessity of cleanliness in swimming pools (Circular 1503. London: H.M. Stationery Office, price 1*d.*). The circular emphasises the opportunity which the winter months offer for ensuring a proper standard in swimming baths and pools. The requisite degree of purity can best be maintained by efficient continuous filtration and continuous controlled chlorination. The recommendations apply to all baths and pools open to the public, whether publicly or privately owned, for local authorities. under the Public Health Act, 1875, have power of control over privately owned pools used by the public.

Pathology and Bacteriology at Leeds

THE annual report for 1934 of the Department of Pathology and Bacteriology in the University of Leeds has been issued, and gives a brief account of the routine and research work prosecuted under the direction of Profs. Stewart and McLeod. The research work includes studies on industrial pulmonary diseases, diphtheria, immunity, and catarrhs of the respiratory tract. Prof. Passey contributes an abstract of work done in cancer research.

Harrison Memorial Prize, 1935: Dr. L. E. Sutton

AT the meeting of the Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society, held on December 12, it was unanimously decided that the Harrison Memorial Prize for 1935 should be awarded to Dr. Leslie Ernest Sutton. The presentation of the Prize will be made at the annual general meeting of the Chemical Society to be held at the University of Bristol on Thursday, April 16, 1936. Dr. Leslie E. Sutton was educated at Watford Grammar School, and proceeded to Lincoln College, Oxford, in 1925, obtaining his B.A. and B.Sc. with first-class honours in 1929. He was elected senior research scholar of the Department of Scientific and Industrial Research in 1929, and obtained his D.Phil. and fellowship of Magdalen College in 1932. He worked with Prof. P. Debye at Leipzig and with Prof. L. Pauling at the California Institute of Technology, Pasadena, and during the past five years he has been carrying out research at Oxford. His original investigations on dipole moments, including the relation between moments and orientation in benzene substitution, on valency angles, and on electron diffraction are of outstanding merit, and form a notable contribution to our knowledge of physical chemistry.

"Everyday Science" and the Civil Service Commissioners

OUR leading article this week deplores the removal from examinations for higher administrative posts of the Civil Service of the compulsory subject "Everyday Science". In this connexion, Sir Arnold-Wilson put a question in the House of Commons asking the Secretary to the Treasury "whether he is aware that the Civil Service Commissioners have eliminated the subject of everyday science, which has been one of the obligatory subjects for competitive examinations for the administrative group of Government service, from next year's examinations; and whether, before taking this decision, the Civil Service Commissioners consulted any society or body representing educational and scientific interests". The reply given on December 16 by the Financial Secretary to the Treasury was as follows: "The answer to both parts of the question is in the negative." The curtness of the reply borders almost on discourtesy to the scientific and educational bodies concerned; and we trust that the matter will not be left in the present unsatisfactory position.

Scales of Ordnance Survey Maps

IN reply to a question by Colonel A. W. Goodman in the House of Commons on December 12, the Right Hon. Walter E. Elliot, Minister of Agriculture, stated that "no decision has been taken to introduce the metre as a unit of measurement in Ordnance Survey maps. The question is among those to be examined by the Departmental Committee, which is at present considering the future programme of the Ordnance Survey Department."

Committee against Malnutrition

IN the anniversary address to the Royal Society (NATURE, Dec. 7, p. 895), Sir F. Gowland Hopkins mentioned a "self-constituted committee" issuing "propaganda against malnutrition". This Committee —a body of research workers and members of the medical profession—is the Committee against Malnutrition, 190 Eagle Street, Holborn, W.C.1. The Committee issues a two-monthly bulletin dealing with all aspects of modern nutritional research and of malnutrition as a social question. The annual subscription is 3*s.*, and in the case of associates 5*s.*, a sum which entitles them to the full use of the files and library of the Committee.

Fifth Mount Everest Expedition

IT is announced that the party which will make the fifth attempt to climb Mount Everest in the 1935–36 expedition under the leadership of Mr. Hugh Ruttledge has been chosen by the Mount Everest Committee, of which Major-General Sir Percy Cox is chairman. The members of the party will be Mr. E. E. Shipton, leader of the Mount Everest reconnaissance party in Tibet; Mr. F. S. Smythe, who has taken part in three previous expeditions; Mr. P. Wyn Harris (Kenya Civil Service); Dr. C. B. Warren, formerly of St. Bartholomew's Hospital; Mr. E. G. H. Kempson, a master at Marlborough College; Major C. J. Morris, late 2nd/3rd Gurkha Rifles; Dr. Noel Humphreys, who led the Oxford University Expedition to Ellesmere Land last year; Lieut. W. R. Smijth-Windham, Royal Corps of Signals; Lieut. J. M. L. Gavin, Royal Engineers; Mr. F. H. L. Wigram, a medical student at St. Thomas's Hospital; and Lieut. P. R. Oliver, South Waziristan Scouts.

Physical Society's Exhibition

THE twenty-sixth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 7, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. Manufacturers of scientific instruments will be exhibiting their products in the Trade Section. The Research and Experimental Section will contain contributions from research laboratories, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the Craftsmanship and Draughtsmanship Competition by apprentices and learners will be on view. Discourses will be delivered on two days at 7.45 p.m. as follows: January 7, R. A. Bull, "Some Instruments used in recording Sound on Film"; January 8, R. W. Paul, "Electrical Measurements before 1886". Admission to the exhibition is by ticket only. Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7.

American Association for the Advancement of Science

THE American Association for the Advancement of Science will hold its ninety-seventh meeting at St. Louis, commencing on December 30. On the first evening, the retiring president, Dr. Edward L. Thorndike, will deliver an address entitled: "Science and Values". Among the special lectures are J. B. Taylor, "The Electric Eye and the Human Eye" (Sigma xi Address); Prof. J. E. Woodridge, "The Claims of Science" (first of series of annual lectures to be arranged by the United Chapters of Phi Beta Kappa); Dr. H. G. Moulton, "The Scientific Method in the Investigation of Economic Problems"; Dr. B. A. Houssay, "Hypophysis and Metabolism"; Dr. Karl F. Meyer, "Plague, Past and Present"; Dr. E. H. Barbour, "The Proboscidea of the Plains"; Prof. F. Slocum, "The Changing Picture of the Universe"; Dr. V. O. Knudsen, "The Absorption of Sound in Gases"; Dr. V. Bush, "Mechanical Analysis" (Josiah Willard Gibbs Lecture). A meeting will also be arranged between the secretaries of sections and affiliated societies and representatives of the Press to discuss the broader principles or the technique of the popular presentation of science. Further information can be obtained from the Permanent Secretary, Dr. Henry B. Ward, Smithsonian Institution Building, Washington, D.C.

Announcements

WE much regret to announce the death, which occurred on December 16 at the age of eighty-one years, of Sir Richard Glazebrook, K.C.B., K.C.V.O., F.R.S., from 1889 until 1919 director of the National Physical Laboratory, and from 1908 until 1933 chairman of the Aeronautical Research Committee; also of Mr. P. C. Gilchrist, F.R.S., who was associated with the late Mr. S. G. Thomas in the introduction of the basic Bessemer process for the production of iron, on December 15, aged eighty-three years.

IT is announced that the King has been pleased to appoint Mr. Edgar John Forsdyke, keeper of the Department of Greek and Roman Antiquities at the British Museum, to be director and principal librarian of the Museum, in succession to Sir George Hill, who will retire in Midsummer, 1936.

DR. G. A. YOUNG, chief geologist of the Canadian Geological Survey, has been elected president of the Royal Society of Canada in succession to the late Dr. Reginald W. Brock.

PROF. OTTO LEHMANN, director of the Museum at Altona, has been awarded the Goethe Medal for Science and Art.

A MEDALLION has recently been affixed to the house at Confolens in the Department of Charente, in which the late Dr. Emile Roux, the director of the Pasteur Institute of Paris, was born.

IT has been arranged for a number of the official lectures which are being given in connexion with the Exhibition of Chinese Art at Burlington House, to be published in the *Journal of the Royal Society of Arts*. The first of these, "The Chinese Exhibition", by Sir Percival David, has already appeared, and Miss Helen Fernald's lecture on "The T'ang T'ai Tsung Horses" is being published on December 20. Copies may be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2, price 1*s*. each.

A SPECIAL section of the Illuminating Engineering Society to be devoted to photometry and allied subjects is now being formed. The honorary secretary is Mr. K. F. Sawyer, of the Gas Light and Coke Company, Watson House, Nine Elms Lane, London, S.W.8. Arrangements have been made for the opening meeting to take place at the Westminster Technical Institute, Vincent Square, London, S.W.1, at 6.30 p.m. on January 28. An introductory address, dealing with certain outstanding problems in photometry, will be delivered by Dr. J. W. T. Walsh.

ERRATUM.—In the communications by G. Wald entitled "Pigments of the Bull Frog Retina" (NATURE, Nov. 23, p. 832) and "The Visual Purple System in Marine Fishes" (NATURE, Dec. 7, p. 913), the ordinates of the graphs should read "Extinction (log I_0/I)" instead of "Extinction (109 I_0/I)" as printed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A John William Hughes professor of civil engineering in the University of Liverpool—The Registrar (Feb. 10).

A principal of the Leathersellers' Technical College—The Clerk to the Governors, Leathersellers' Hall, St. Helen's Place, London, E.C.3.

An engineer to the Government of Nigeria—The Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 991.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Biometrical Studies on Herbarium Material

ONE type of information concerning species is almost universally lacking in herbarium material, even in that of the most copiously collected species and varieties of plants. Because the lack seems to be due to a general failure to appreciate the value of such information, it has seemed wise to direct attention to the problem, and to indicate methods of dealing with it.

For species which are well represented in herbaria, one can now obtain from the preserved specimens a substantially accurate record of the general range of variation. Seldom or never, however, is it possible to ascertain the comparative frequency of the different variants. In *Fraxinus Pallisae*[1], for example, it is difficult to decide whether one is dealing with various departures from a common morphological central type, or whether the bulk of the population is grouped around two or more extremes with occasional intermediates between them. If information as to frequencies were at hand, it would very probably be possible to diagnose one variable but still coherent species, or, alternatively, to explain the result as due to hybridisation.

In such variables as *Fraxinus Pallisae* and *F. oxycarpa*, it is possible to supplement the customary herbarium material with another kind of specimen which will supply exactly the information which is ordinarily lacking. These supplementary specimens need be little or no more laborious to collect than ordinary ones, nor, if the work be critically done, need they take up undue space in the herbarium. All that is needed, in addition to the kind of specimens usually collected, is a series giving a random sample of the population. This need not consist of complete specimens; any critical portion of the plant will probably suffice. In *Fraxinus*, for example, one leaf per tree, from every tree in a small copse, or from a random sample of the trees in a forest, can be mounted several to a sheet. While the specimens need not be bulky, they should be carefully chosen to be as comparable as possible; in *Fraxinus* they should all be leaves in the sun, or all in semi-shade; they should all be either from fruiting or non-fruiting branches, and if possible from trees of about the same age. Different genera will require other sorts of material. In *Iris* one seed from every one of the plants in a meadow, in *Prunus* one average 'stone' per tree from all the trees in a single mountain valley or along a certain length of beach, in *Centaurea* one head from every plant growing on an area of down, will produce collections which can be filed in packets on a single sheet. Such collections, however, if carefully gathered, will yield valuable and unique biological information.

It is important, of course, that, where great numbers of individuals make it necessary for the collector to choose relatively few, the choice be made as representative as possible. One of the simplest ways of accomplishing this result is to collect along a line (or if necessary along a series of parallel lines) until the necessary number of individuals has been sampled. With low-growing plants it is usually a simple matter to sight across such a community as a meadow or a bog where the plants are growing and to pick out a route which will be representative, and then to collect comparable fragments (leaves, flowers, seed-pods, etc.) of every plant along this line. Some modification of this method will ordinarily suffice for larger-growing species, though more mathematically refined methods for taking such samples might readily be devised[2]. The number of individuals collected will depend, of course, upon the ease of collection, and to a certain extent upon the needs of the particular problem under investigation. Generally speaking, at least twenty-five will be necessary before one can place much confidence in the result, while samples of more than fifty may not give such improved results as to justify the extra labour.

In our opinion, such collections, if once made, should be filed together, even though they may include two or more species. Once separated into their specific components, they are difficult and sometimes impossible to reunite. Cross-references can be made on the orthodox herbarium material, which, of course, should be collected at the same time. There does not seem to be any inherent difficulty either in assembling such material or in filing it in a regular herbarium. It is to be hoped that such collections may be made more frequently, especially from species or groups of species which are difficult or impossible to diagnose precisely by more orthodox taxonomic methods.

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[1] Tedd and Turrill, "*Fraxinus Pallisae* and its Relationships", *Kew Bull.*, 132; 1935.
[2] A. R. Clapham, "The Form of the Observational Unit in Quantitative Ecology", *J. Ecol.*, 20, 192; 1932.

Meaning of Certain Constants in Use in Physics

RECENT discussions as to electrical units have led to a consideration of the meaning of the constants μ, K, A, employed in electrical theory. It appears that each of these is needed, as a link, to allow us to express in dynamical ('absolute') units the forces active between certain electrical and magnetic quantities. Thus we have

$$\text{Force} = mm'/\mu r^2$$

and two similar equations, where m, m' are quantities of magnetism.

It is of course the case that μ, or more accurately μ/A, measures the ratio of magnetic induction to magnetising force, the permeability of the medium, while K, or rather $K/4\pi$, is a measure of its permittivity, the ratio of electrical displacement to electric force, but these facts are consequences of theory rather than fundamental definitions of the coefficients μ and K. The object of this note is to direct attention to the fact that many other coefficients used in physics share this role with μ and K.

Hooke's law, "Ut tensio sic vis", might be made the basis of a definition of force; indeed, it is used in the spring balance as a measure of force. A coefficient, Young's modulus, gives us the link by means of which we can express the stretch (tensio, extension) of a spring or piece of elastic in dynamical measure. This is true of all coefficients of compressibility or rigidity. By means of them we are enabled to express dynamically the pressures or tractions required to change the volume or shape of a body by a given amount.

Nor is this use of a coefficient limited to cases in which force is one of the quantities measured. Heat is properly measured as energy; it can also be measured by the rise of temperature produced in a given mass of water. Joules' equivalent is a coefficient which enables us to express a rise of temperature as the ratio of energy to the mass of water; the result is not completely 'absolute', for it involves certain properties of water.

Or again, to take a case involving, no doubt, the properties of a quantity of electricity, the electron, Planck's constant gives us the ratio of a quantity of energy to the frequency of an electron and thus enables us to express the frequency of an electron in dynamical units.

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Production of Neutrons by Annihilation of Protons and Electrons According to Fermi's Theory

IN the theory of β-decay as proposed by Fermi[1], one assumes the existence of elementary processes in which a neutron is transformed into a proton by simultaneous creation of an electron and a neutrino. For the inverse process, which is also naturally contained in Fermi's theory, one needs the previous existence of an electron and a neutrino. It might therefore be thought that a proton cannot be transformed into a neutron without the presence of a neutrino source. Such a source, however, is not necessary if it be admitted that in empty space all negative neutrino states are occupied in the same way as the negative energy states of the electron in Dirac's theory of the positron. In this case, for example, the presence of an electron alone is sufficient since the neutrino can be furnished from a negative state.

The transformation of protons into neutrons by positron emission has already been treated by Uhlenbeck and Wolfe[2]. Of course, it could only occur if for the masses M_P, M_N and m of proton, neutron and electron respectively, the relation

$$D = M_N c^2 - M_P c^2 < -mc^2 \qquad (1)$$

were valid. Recent data for the neutron mass seem to exclude such a relation.

By a process of the kind mentioned above, however, the proton in the hydrogen atom together with the electron can be transformed into a neutron, if

$$D < mc^2 - J, \qquad (2)$$

J being the ionisation energy.

Since, at present, relation (2) cannot be excluded with certainty, we have calculated the rate of transition of a hydrogen atom into a neutron. The result depends somewhat on the form of the interaction between the heavy particle and the electron-neutrino field. We have used two such forms, that proposed originally by Fermi (l c.), the other by Konopinski and Uhlenbeck[3], and we find in the former case:

$$R' = \frac{\Delta^2}{T}; \qquad (3a)$$

and in the latter, $$R'' = \frac{\Delta^4}{T}; \qquad (3b)$$

where $$T = \frac{2\pi^2\hbar^4}{g^2\alpha^3 m^2 c} = 8\cdot 8 \times 10^{10} \text{ sec.} \qquad (4)$$

and $$\Delta = \frac{mc^2 - J - D}{mc^2} \qquad (5)$$

g is the universal constant as determined by the β-decay with the value $g = 4 \times 10^{-50}$ cm.^{3} erg; $2\pi\hbar$ is Planck's quantum of action; α is the reciprocal of the Bohr radius; c is the velocity of light; and J is the ionisation energy of the hydrogen atom.

If by a very cautious estimation we assume that the lifetime of hydrogen is certainly longer than 10^{13} sec., we find as a lower limit of D from (3a):

$$D > 0\cdot 9\ mc^2 = 4\cdot 5 \times 10^5 \text{ e.v.}; \qquad (5a)$$

from (3b):

$$D > 0\cdot 6\ mc^2 = 3 \times 10^5 \text{ e.v.} \qquad (5b)$$

Since it is very likely that not only are the relations (5) satisfied but also that D is considerably larger than mc^2, a transformation of protons into neutrons could only occur by bombardment with electrons of high energy. We have also treated this case neglecting the Coulomb interaction between the proton and the electron. For the cross-section we obtain with

$$\Gamma = \frac{E - D}{mc^2},$$

in the Fermi case

$$\Phi' = A\frac{c}{v}\Gamma^2; \qquad (6a)$$

in the Uhlenbeck case

$$\Phi'' = A\frac{c}{v}\Gamma^4. \qquad (6b)$$

E and v are energy and velocity of the incident electron; A is the universal area

$$A = \frac{g^2 m^2}{2\pi\hbar^4} = 1\cdot 7 \times 10^{-44} \text{ cm.}^2 \qquad (7)$$

The smallness of the value (7) will scarcely permit detection of our effect, although it increases rapidly with the electron energy. Our calculations have been carried out on the assumption that the mass of the neutrino is small compared with the mass of the electron. In addition, for simplicity, terms of the order m/M have been neglected.

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Oct. 26.

F. BLOCH.
C. MØLLER.

[1] E. Fermi, *Z. Phys.*, 88, 161; 1934.
[2] *Phys. Rev.*, 46, 237; 1934.
[3] *Phys. Rev*, 48, 7; 1935.

Conditions Determining the Intensity of X-Ray Reflections from Microcrystalline Layers

THE letter of Messrs. Stephen and Barnes on a "New Technique for Obtaining X-Ray Powder Patterns" in NATURE of November 16, p. 793, raises some points of interest with regard to the geometrical-optical conditions governing the device they describe.

As is done in the flat layer method we have developed[1], they observe X-ray reflections from a flat microcrystalline layer by making use of wide beams. The X-ray source is at some distance from the camera and the layer is set so as to make only small glancing angles with the reflected rays. Such conditions correspond to our focusing relation $\sin \alpha / \sin \beta = a/b$ for the case $a > b$. In Fig. 1, this relation is illustrated by reference to the 'toroidal' surface, discussed in previous papers[2], which determines the locus of the points so situated as to reflect from a source A to C through an angle $2\pi - (\alpha + \beta)$. Since the magnification between A and C depends on the zone of the toroid, by making $a > b$ a reduced image of the source with a corresponding increase of intensity can

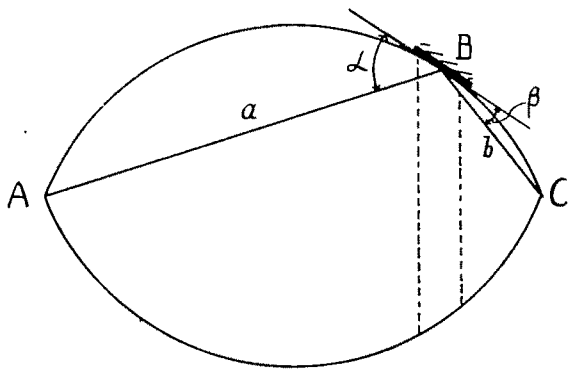

FIG. 1.

be obtained. Apart from this factor of magnification, the intensity is determined by the angular width of the incident beam. To obtain the maximum intensity we have met these combined requirements by placing the source A, which generally is a slit, back in the anticathode itself. The multiple diaphragm used by Messrs. Stephen and Barnes approximates to these conditions, as for a parallel beam $a = \infty$, when the focusing relations always requires the angle β to be small. It would thus appear that their method is in its principles the same as our method of the flat layer. Although they do not use the term focusing, the sharpening of lines and the increased intensity with shortening of exposure are two aspects of focusing and scarcely involve a new principle, claimed in the letter.

This view seems to be supported by Dr. W. H. George's elegant method[3] referred to in Messrs. Stephen and Barnes' letter, of obtaining a strong monochromatic reflection from a copper crystal cut so that its surface is oblique to the reflecting lattice planes. This corresponds to the reflection from an element of the toroid with $a \neq b$, and is entirely accounted for by the focusing relations; we described this in our earlier discussion by saying "that the lattice planes from which reflection takes place are inclined to the surface of the toroid like the tiles of a roof". They are indicated in Fig. 1 by the shaded lines at B.

We look forward to finding in the more extended publication foreshadowed by Messrs. Stephen and Barnes a fuller exposition of the distinctive features of their method and of the underlying principles. In some measurements with a source A at finite distance and a flat microcrystalline layer, we found that with decrease of β below the angle of focusing the intensities did not increase but decreased in accordance with an absorption effect[4] which could not be discussed within the limits of this letter.

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[1] J. Brentano, NATURE, 112, 652; 1923. *Proc. Phys. Soc.*, 37, 184; 1925.
[2] J. Brentano, *Arch. Sci. Phys. et Nat.*, (4), 44, 66; 1917, (5), 1, 550; 1919. Also loc. cit.
[3] W. H. George, NATURE, 136, 180, Aug 3, 1935.
[4] J. Brentano, *Z. Phys.*, 70, 74; 1931. *Proc. Phys. Soc.*, 47, 932; 1935.

Variation in the Lattice Constant of Zinc Oxide

IN the course of electron diffraction investigations, it is often necessary to have a more accurate method of measuring voltage than the spark gap affords. Reference films have been used by several workers, the electron voltage being calculated from the lattice constant as known from X-ray work. Gold films were originally used, but more recently metallic oxide films have been preferred, as they yield very good diffraction patterns. The use of such films obviously demands that the crystal structure shall be stable and the lattice dimensions constant.

During the past three years, I have been using both gold and zinc oxide films in this way. Whilst the former have behaved uniformly well, the latter have showed small but consistent variation in lattice constant, as tested against a high-resistance voltmeter. It is conceivable, but scarcely possible, that both the voltmeter and gold film varied, and that the zinc oxide films were actually stable.

The oxide films were prepared by withdrawing a brass washer of 5 mm. diameter from a skimmed melt of granulated zinc contained in a crucible. The lattice constants of such a newly prepared film were found to be: $a = 3{\cdot}234 \pm 0{\cdot}005$ A.; $c = 1{\cdot}615 \pm 0{\cdot}005$ A. After an interval of one year, during which the film was protected from dust but was exposed to the air, the constants were found to be: $a = 3{\cdot}262 \pm 0{\cdot}005$ A.; $c = 1{\cdot}628 \pm 0{\cdot}005$ A. Six months later the values were found to be slightly higher still: $a = 3{\cdot}279$ A. and $c = 1{\cdot}637$ A., with the same probable error as before. No changes in these latter values were observed after the lapse of a further two months. To check this drift in the lattice constants, a fresh zinc oxide film was then prepared. This gave values very near to those first obtained with the previous film: $a = 3{\cdot}242$ A., $c = 1{\cdot}620$ A. These values compare with those given by Bragg[1]: $a = 3{\cdot}220$ A., $c = 1{\cdot}608$ A.; the difference is not significant, as there is a constant error of $\pm 0{\cdot}5$ per cent in the present work, owing to uncertainty as to the camera length. This error will affect all the values equally, and therefore can have no part in causing the observed drift.

The fact that the lattice constants of zinc oxide films vary in this regular way with time, whilst those of gold films remain constant, must be the result of stresses set up in the films during the rapid cooling

which accompanies their formation, possibly aided by gas absorption. No work has been done on films obtained by collecting zinc oxide smoke[2]. The present results show, therefore, that it is inadvisable to use films of zinc oxide, prepared in the manner described, for high-voltage calibration or measurement.

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Oct. 31.

[1] Bragg, *Phil. Mag.*, 39, 647, 1920.
[2] Finch and Quarrell, *Proc. Phys. Soc.*, 46, 148; 1934.

Ascorbic Acid (Vitamin C) and Phytocarcinomata

IN a previous communication[1], I have given an account of a phytocarcinogenic effect of œstrus hormone on tomato plants. In a similar preliminary experiment using the same technique[2] with tomato plants, about 55 cm. high, the effect of ascorbic acid upon plant-tumour production has been investigated.

Immediately after the inoculation of fifteen plants with *B. tumefaciens*, a 1/10,000 aqueous solution of ascorbic acid (kindly supplied by Prof. A. Szent-Gyorgyi) was introduced through a petiolar stump. The average total dose thus absorbed was about 27 ml. per plant during the period June 8–22, 1935 Five of the fifteen were tentatively given, on the first day of the experiment, 5 ml. of a concentrated (5/1,000) solution of ascorbic acid. Although the petiolar stump, through which this dose was absorbed, plasmolysed and completely collapsed within 38 hours, no other toxic effects were observed. Afterwards, the dilute solution was given to these plants through another petiolar stump. Twenty-one plants were set up as controls, and treated with an equal amount of water.

At the first signs of necrosis of the experimental tumours, they were cut off and weighed. The average weight of the tumours per plant was: with ascorbic acid, 1·116 gm.; with water only, 0·857 gm. The mean weight of the tumours of the plants treated with ascorbic acid was about 27 per cent greater than that of the control plants, although the total amount of crystalline ascorbic acid administered throughout the treatment amounted only to about 2·7 mgm. per plant; owing to its rapid oxidation in solution, the amount actually absorbed is estimated to have been 40–50 per cent less.

The hydrogen ion concentration of the sap of the treated plants and controls, and of the tumours severed from these plants, was as follows (mean values):

	Concentration of solution	*p*H 24 hours after absorption of first solution	*p*H at end of experiment
Leaves	1/10,000	5·6	5·6
	5/1,000	5·4	5·6
Leaves and stem	1/10,000	—	5·5
	5/1,000	—	5·5
Tumours	1/10,000	—	5·8
Leaves	0 (controls)	5·6	5·6
Leaves and stem	0 "	—	5·5
Tumours	0 "	—	5·8

With the exception of the slight lowering of the *p*H of leaf-sap extracted twenty-four hours after the administration of the stronger solution of ascorbic acid, the acid does not appear to have affected the hydrogen ion concentration of the sap extracted from the treated plants. The greater alkalinity of tumour sap is a characteristic of most tumour tissues.

Histo-cytological examination of tumours from the treated and control plants gave no indication that the increased size of the tumours severed from treated plants was simply due to the stretching of the cells caused by a general stimulation of somatic growth under the influence of ascorbic acid[3]. As the size and arrangement of the cells and that of the phloem-xylem elements were identical in the two, it is deduced that the treatment led to an increase of cell proliferation of the pathological tissues.

It is hoped to extend the range of the experiment outlined above, in order to test whether a parallelism exists, for plants, with the findings of Fodor and Kunos[4], Schroeder[5], and Frisch and Willheim[6], concerning the carcinogenic influence of ascorbic acid on animals.

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Nov. 14.

[1] Havas, L., NATURE, 136, 516, Sept 28, 1935.
[2] Havas, L., and Caldwell, J., *Ann Bot.*, 49, 731, 1935.
[3] Havas, L., NATURE, 136, 485, Sept. 14, 1935.
[4] Fodor, E., and Kunos, St., *Z. Krebsforsch.*, 40, 484, 1935.
[5] Schroeder, H., *Klin. Wochenschr.*, 14, 484; 1935
[6] Frisch, C., and Willheim, R., *Biochem. Z.*, 277, 148; 1935.

A New Type of Plant Lipochrome

IN continuation of our investigations upon the Algæ[1], we have observed the presence of a peculiar carotenoid in the unsaponifiable fraction of one of the *Cyanophyceæ* (*Myxophyceæ*), namely, *Rivularia nitida*. The pigment, for which we propose the name *myxoxanthin*, crystallises from ether-methyl alcohol in deep copper-coloured needles, m.p. 117°–118° (uncorr.), and unlike any other phytocarotenoid hitherto isolated, exhibits only one absorption band, having its head at 488–490 mμ in carbon disulphide. In this respect myxoxanthin resembles the Crustacean pigment astacene[2]; but unlike the latter, it has no acidic properties and is completely epiphasic when subjected to the Kraus partition between methyl alcohol and light petroleum. Its failure to yield a sodium salt precludes the possibility of its being hæmatochrome, which pigment is reputed to exist in certain Algæ and is likewise stated to possess only a single absorption band[3].

We have failed to detect the presence of any hypophasic xanthophylls in *Rivularia nitida*, and the absence of these is, so far as we are aware, unique in plant life, although we have found that *Trentepohlia aurea*, a member of the *Chlorophyceæ*, contains only a minute amount of hypophasic xanthophylls, the yellow colour of the plant being due almost wholly to its high β-carotene content. We are at present engaged in collecting a larger amount of *Rivularia nitida* with a view to a closer characterisation of the new pigment.

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R. F. PHIPERS.

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Nov. 28.

[1] Heilbron, Phipers and Wright, NATURE, 133, 419; 1934. *J. Chem. Soc.*, 1572; 1935. Heilbron and Phipers, *Biochem. J.*, 29, 1369; 1935. Heilbron, Parry and Phipers, *Biochem. J.*, 29, 1376, 1382; 1935.
[2] Kuhn and Lederer, *Berichte*, 68, 488; 1933.
[3] Kylin, *Z. phys. Chem.*, 166, 39; 1927.

Structure of the Proboscis in Blood-sucking Diptera

IN his letter in NATURE[1], Dr. S. K. Sen still upholds the view, which I have criticised[2], that the salivary duct of *Stomoxys calcitrans* terminates at the base of the hypopharynx, the lumen of the latter being a groove running centrally to near its tip.

The hypopharynx (*h.*) of Diptera is formed by an external and an internal tube. The external tube or the external wall of the hypopharynx of *S. calcitrans* (*e.t.*) is formed by the evagination of the floor of the mouth-cavity and is crescent-shaped in transverse sections (Fig. 1). The internal tube (*s.d.*) represents the elongated anterior portion of the common salivary duct and is rounded. Even in *Culicoides*, where the hypopharynx is partly guttered, the part of the salivary duct forming this gutter extends to near the tip of the hypopharynx.

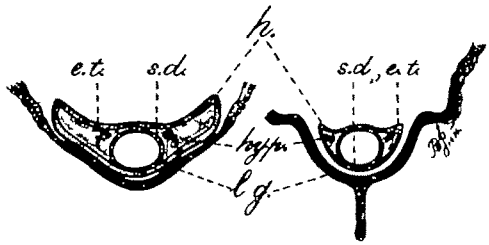

FIG. 1.

What Dr. S. K. Sen has named hypopharynx in his drawing (No. 2) of the transverse section of the proboscis of *S. calcitrans*[3], is actually the most anterior part of the hyoid. His section was evidently cut posteriorly to the base of the hypopharynx.

Fig. 1 shows transverse sections of the hypopharynx of *S. calcitrans* cut through the basal and the distal part of this organ respectively. The drawings also show the position of the hypopharynx in the labial gutter (*l.g.*) and the hypodermis (*hyp.*) occupying the space between the salivary duct (*s.d.*) and the external wall (*e.t.*). In these drawings I have intentionally not shown the theca of the labium, which lies ventrally to the labial gutter, nor the labrum-epipharynx, which lies dorsally to the hypopharynx.

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[1] NATURE, 136, 479, Sept. 21, 1935.
[2] NATURE, 136, 145, July 27, 1935.
[3] NATURE, 135, 915, June 1, 1935.

Surface Structure beneath the Pacific

IN a letter in NATURE of November 2, p.723, it is stated by Mr. H. F. Baird, acting director of Apia Observatory, that I have found from the velocities of seismic surface waves evidence of the existence of a layer of granite some 10 km. thick below the Pacific Ocean. This statement, based on an abstract only of my paper, is liable to be quite misleading. One extract from the actual paper will make the position clear: "Our ignorance of the structure of the Pacific floor gives no ground for applying the theory of a double surface-layer; it might be worth applying a single layer theory if we had any idea of the properties of that layer. The order of magnitude of the thickness of an equivalent single layer of granite can be found. . . ." If that layer happens to be granite, then the theory gives 10 km. with fair accuracy; if diorite, the thickness is about 16 km.

Independent evidence of the nature of the Pacific floor is badly needed, and it is important that Mr. Baird should have found some evidence of upper and "intermediate" layers from the records of earthquakes that occurred near Samoa. Some years back I endeavoured to trace pulses analogous to P_g, S_g, P^* or S^* in the Suva and Apia readings recorded in the "International Seismological Summary", but without success. A network of seismological stations on some of the Pacific islands, even if established for a limited period of a few years, would give valuable information concerning the structure of the earth's crust beneath the Pacific Ocean.

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Electrical Moments of *p*-Quinone and Related Compounds

A DETERMINATION of the electric dipole moment of *p*-benzoquinone in benzene solution by Hassel and Naeshagen[1] gave the value of 0·67 D (D = 10^{-18} E.S.U.). Since *p*-quinone is usually assigned a symmetrical planar structure which should have zero moment, a further investigation of this anomaly was undertaken. The re-measurement confirmed Hassel and Naeshagen's value, and the work was extended to similar compounds with the following results:

Compound	Solvent	Temp.	P_{A+O}	μ
p-Benzoquinone	Benzene	25·0° C.	8·9 c.c.	0·65
"	Carbon tetrachloride	"	9·6 "	0·68
"	*n*-Hexane	40·0° C.	8·6 "	0·66
2 : 5 Dimethyl-1 : 4 quinone	Benzene	25·0° C.	9·4 "	0·68
2 : 5 Dichloro-1 : 4 quinone	"	"	8·8 "	0·64
Tetramethyl-*cyclo*butane-1 : 3-dione	"	"	11·0 "	0·73

The possibility of polar impurities being present can definitely be ruled out, since different specimens prepared or purified by different methods gave identical results. As regards a solvent effect, the values for *p*-quinone in benzene, carbon tetrachloride and *n*-hexane are identical within experimental error, and so if the moment is to be attributed to a solvent effect, it cannot be a specific effect of one solvent.

The construction of a model for *p*-quinone indicated that the molecule was not nearly as rigid as the graphic formula would lead one to expect, only a small force being required to distort the molecule into a multiplanar configuration by simultaneous rotation about the four single bonds.

If a strain of 10° in the carbon angle is produced by an increase in energy of 750 cal. per gram molecule[2], it follows that thermal energy at ordinary temperatures would be far more than sufficient to cause the observed moment for *p*-quinone. Pauling and Sherman[3] have calculated the resonance energy of *p*-quinone, and find the large value of 13,000 calories, and it is probably this high resonance energy which tends to prevent the above type of oscillation in the quinone molecule.

The moments observed for 2 : 5 dimethyl- and 2 : 5 dichloro-*p*-quinone, being the same as that of *p*-quinone itself, offer a serious objection to the flexibility theory. The theory was further tested by measuring the moment of tetramethyl-*cyclo*butane-1 : 3-dione, where, owing to the large strain already present in the four-membered ring, a further

distortion of the molecule should not occur. A small moment, however, of the same order of magnitude, is also found in this case. The tetramethyl derivative was used rather than *cyclo*butane-dione itself, since with the latter compound there is the possibility of enolisation.

From these results it would appear that the values observed for the moments are due either to a general effect of the solvent or to an abnormally large atom polarisation. The question can best be settled by measuring the moments of the substances in the vapour state, and this work is being undertaken.

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Nov. 8.

[1] *Z. phys. Chem.*, B, **6**, 441; 1930.
[2] *Ann. Rep.*, 65; 1932.
[3] *J. Chem. Phys.*, **164**; 1933.

Occurrence of the Dipterocarpaceæ-Dipterocarpoideæ in Africa

IN a paper read before the Imperial Botanical Conference last August, which is being published in the forthcoming number of the *Empire Forestry Journal*, I referred to the Monotoideæ as "the only known living African representatives of the family Dipterocarpaceæ".

The Imperial Forestry Institute has now received herbarium material of a true Dipterocarpoid tree, from Nigeria, where it was found by Mr. J. H. Mackay, assistant conservator of forests, growing in primitive forest. Two further records of a similar species, and from other areas, have now been reported by Dr. Helen Bancroft, who has recently described the structure of true dipterocarp wood found in a fossil condition at Mount Elgon (Kenya-Uganda). Records of similar wood from Italian Somaliland, by Prof. A. Chiarugi, of Pisa, have indicated that the sub-family Dipterocarpoideæ was well represented in Africa in Tertiary times.

The discovery of living members of the Dipterocarpoideæ, a sub-family noted for its very valuable timbers, opens up further possibilities, from the practical point of view, with regard to the utilisation and development of tropical African forest areas. Academically, it adds further evidence of an interrelationship of African-Asiatic types which indicates that in some earlier period there has been a closer connexion between Africa and the Indo-Malayan region, to which I referred in my paper.

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Dec. 3.

Points from Foregoing Letters

IN order to increase the usefulness of herbarium material, and to enable investigators to ascertain not only the range of variation of certain species but also the comparative frequency of different variants, Dr. E. Anderson and Dr. W. B. Turrill recommend that, in addition to the ordinary herbarium material, a carefully selected random sample consisting of 25–50 specimens of some critical part of the plant (such as leaf or seed) should be collected.

The late Sir Richard Glazebrook directs attention to the fact that not only the electrical and magnetic constants μ, K and A, but also many other coefficients used in physics, such as those of compressibility or rigidity, Young's modulus and Joule's equivalent, are in fact ratios between two different methods of measuring force, or energy, in terms of dynamical ('absolute') units.

Drs. F. Bloch and C. Møller have estimated the rate of transition of a hydrogen atom into a neutron, from the theory of Fermi, which allows the formation of a neutron by the combination of a proton with an electron plus a neutrino. They conclude that the transformation of protons into neutrons could only occur by bombardment with electrons of high energy.

Dr. J. Brentano discusses the conditions determining the intensity of X-ray reflections from crystal lattices. He suggests that the technique for obtaining X-ray powder patterns described in a recent letter by Messrs. Stephen and Barnes can be fully accounted for by the general conditions of focusing, which form the basis of his flat layer method previously published.

The lattice constants of zinc oxide films are found by Mr. V. E. Cosslett, using electron diffraction methods, to vary from 3·234 A., immediately after formation from a zinc melt, to 3·279 A. eighteen months later. The latter appeared to be a limiting value. The lattice constant of gold films remained the same over this time, showing that experimental conditions were unchanged. It is, therefore, inadvisable to use such oxide films as standards in electron diffraction work.

Injections of ascorbic acid (vitamin C) into tomato plants are found by László Havas to increase the size of the tumours produced in those plants by *Bacillus tumefaciens*. Mr. Havas recently described similar effects obtained with sex hormones.

A new pigment, myxoxanthin, has been extracted by Prof. I. M. Heilbron, B. Lythgoe and R. F. Phipers from *Rivularia nitida*, one of the blue-green algæ. The new pigment belongs to the carotene series, but unlike other plant pigments of that nature it has a single absorption band in carbon disulphide solution (maximum at 4880–4900 A.), and resembles in this respect the pigment astacene obtained from crustacea.

If we had independent knowledge of the composition of the sub-Pacific crust, observations of the surface waves of earthquakes would enable the thickness to be calculated. Dr. R. Stoneley, in commenting on a letter by Mr. H. F. Baird (NATURE, Nov. 2, p. 723), points out that valuable information about the Pacific floor could be obtained if a number of seismological stations were established on Pacific islands.

D. Ll. Hammick, G. C. Hampson and G. I. Jenkins have found that *p*-benzoquinone, its symmetrically substituted derivatives and tetramethyl-*cyclo*butane - 1 : 3-dione all have small but finite electrical moments when measured by the solution method. This is anomalous in view of the symmetrical structure usually assigned to these compounds and may be due to a general effect of the solvent or to an abnormally large atom polarisation.

Research Items

Norwich 'Woodhenge'

SOME further results of the excavation of the recently discovered 'Woodhenge' (see NATURE of September 7, p. 365) are described by Mr. J. G. D. Clark in *Antiquity* of December. When excavation began in August last, two rings were observable, of which the inner was interrupted by what was evidently a causeway; but the central area showed no signs of post-holes or other features. An eleven foot section was cut from outside the circle, this running for a distance of 100 ft. in all. Both the inner and the outer ditch proved to be shallow relatively to their width, and between them were the remains of a bank, much ploughed down. The outer ditch produced some third century Romano-British sherds from above a sterile layer overlying the primary silting. The inner ditch produced stratigraphical evidence of importance. Below three feet of infilling, ploughed in when chalk was used to marl the ground, down to the bottom of a black zone, were quantities of early iron age pottery, yet to be examined, and a strong admixture of Romano-British material, which appears to date from the third century of the Christian era. Evidently the iron age levels had been disturbed in Romano-British times. Below the iron age level was a sterile zone of primary infilling on a thin charcoal stratum on the floor of the ditch. This produced sixteen sherds of pottery and three or four 'crumbs' of the same ware, resembling 'beaker' on the inside and decorated in rusticated finger-nail style on the outer surface. The central area was stripped to the gravel and sand. There proved to be eight, not nine, post-holes, the timber part of the monument being on the horse-shoe plan, resembling the arrangement of the inner horse-shoe of blue-stones and of the trilithons at Stonehenge. The set of the ramps of the post-holes points to the erection of the timber uprights before the construction of the inner ditch.

Wild Cat and Domestic Cat

As the result of the measurement of a large number of Scottish wild cats (*Felis sylvestris*), including 42 specimens received complete in the flesh and 70 skulls, John C. Kirk publishes a useful comparison between the wild and domestic cats (*Scottish Naturalist*, 161; 1935). Domestic cats which have run wild soon assume the characters of the wild race, developing longer and coarser fur, longer limb-bones and larger teeth, and after two or three generations in a wild state would be scarcely distinguishable from the true wild cats, and the author thinks that probably there is a certain amount of domestic blood in the wild cat of the present day. In spite of these difficulties and of the fact that no single feature in the skull of the wild cat may not occasionally be duplicated in the domestic cat, the author gives a series of distinguishing marks which can generally be relied upon. On the whole, while the lower jaw is more strongly developed and the muscular ridges of the skull are strongest in the wild cat, the bones of the cranium are generally lighter and thinner than in domestic cats. The wild cat has longer limbs, longer and coarser fur, larger teeth, but shorter small intestine (43–51 in. against 58–66 in.).

Light as a Factor in the Growth of Barnacles

A STUDY of the distribution of the common barnacle (*Balanus balanoides*) upon the different sides of the wharf of the Atlantic Biological Station has led Prof. A. Brooker Klugh and Curtis L. Newcombe to correlate the differences with amount of sunlight (*Canadian J. Res.*, 13, 39, Sept. 1935). A significant correspondence was found between the rate of growth of the barnacles and the amount of illumination. Moreover, the difference between the amount of growth at widely separated vertical levels was similar to the difference in areas on the same level where there was wide variation in the amount of illumination.

Zoology of the Voyage of the *Belgica*

Two recent monographs (Expedition Antarctique belge, Resultats du Voyage de la Belgica en 1897–99 sous le Commandement de A. de Gerlache de Gomery. Rapports Scientifiques. Zoologie. Anvers, 1935) deal with the Pycnogonida (by Louis Giltray) and the Oligochæta by (Leon Cĕrnosvitov). There are few pycnogonids, but these are interesting and include a new species of *Nymphon*, *N. gerlachei*, an abyssal form from 460 m. depth, associated with *N. longicoxa*, Hoek, from Banquisi, lat. 71° 5′ S., long. 89° 3′ W. *N. gerlachei* has a very thin body and long thin legs, probably walking on fine mud. Only one specimen was found—a male. The Oligochætes collected by the expedition consist of eight species, all known forms. A new variety of *Chilota corralensis* is described, living under mosses covering rocks and dead leaves from Lapataia, Terra del Fuego. The type is only known from Corral in Chile, and the present variety, var. *belgicæ*, differs from it in several particulars, especially in colour, form of the body and the situation of the genital papillæ. Immature individuals were also found among roots of plants growing on the rocks near a waterfall in the Island of Londonderry.

A New Family of Sawflies and the Genera of the Cephidæ

MR. ROBERT B. BENSON (*Ann. Mag. Nat. Hist.*, (10), 16, Nov. 1935) has erected a new family, Syntexidæ, for a very interesting species of sawfly, *Syntexis libocedrii*, Rohwer. The species is at present only represented by two adult specimens in the United States National Museum and a few larvæ found boring in the wood of the incense cedar (*Libocedrus decurrens*, Wrr.) in California. The family is placed between the Xiphydriidæ and Cephidæ; but it is really very distinct from either, though heretofore included in the Cephidæ. In dealing with the Cephidæ of the world, five new genera are described; one of these, *Athetocephus*, is erected to contain two peculiar species from Madagascar, only the third and fourth known sawflies from that island. Many new characters used in the keys are illustrated in the twenty line drawings by the author. Attention is directed to the fact that the Cephidæ are not an unspecialised family as is generally supposed, but on the contrary, very highly specialised. In some respects, such as in the presence of a marked constriction at the apex of the basal segment of the abdomen, they show an approach to the formation of a propodeum characteristic of the other great sub-order of the Hymenoptera, the Apocrita.

Histology of Sponges

D. A. WEBB (*Quart. J. Micr. Sci.*, 78, Part 1, Oct. 1935) gives in an article of eighteen pages a useful résumé of the literature published since the beginning of 1914 on the histology, cytology and embryology of sponges. The different kinds of cells and the cytoplasmic inclusions are considered, and the second half of the article is devoted to gametogenesis, fertilisation and embryology. It is remarkable that stages in spermatogenesis are so rare, so that this "process still remains rather a mystery". Authors are, however, agreed that the spermatozoa of sponges are of an ordinary filiform type similar to those of most other animals. The transport of the spermatozoon to the oocyte in *Grantia* by means of an intermediary carrier-cell, as first described by Gatenby, has been confirmed by later workers for *Grantia* and *Sycon*, and for *Cliona* and *Reniera*.

Transpiration and Stomata in Desert Plants

THE first paper to be published by the Faculty of Science of the Egyptian University (*Bull. Fac. Science*, 1, Egyptian University, Cairo, 1934) deals with the vexed question of stomatal control of transpiration in desert plants. Earlier work of this nature is reviewed, and comment and criticism made of the lines of attack, methods of investigation and conclusions of the observers. In these present experiments, the investigators, A. H. Nontasir and A. M. Nigaleid, seem to have taken steps to eliminate some of the errors, often included unwittingly in this type of work, and their experiments have been repeated under varying conditions. An interesting modification is made in the relation of relative humidity to water loss—in this case it is the relative humidity *deficit* of the air which is considered in *direct* proportion to evaporation, which seems a much more rational correlation than that of actual humidity to water loss. The general results indicate once again that stomatal control is almost negligible unless the stomatal aperture is almost closed, that under conditions encouraging maximum evaporation the stomata are wide open, and that when such conditions are removed there is still a time lag in stomatal closure. Actually, in most cases, the water content itself is the most effective limiting factor, resistance to water loss increasing rapidly with falling water content, whilst at the same time spine formation and foliage reduction have a protective effect. Very detailed results of the experiments are given, and the paper is accompanied by a good representative list of references.

Hybrids of Tropical Orchids

A VERY interesting review by M. J. Costantin ("Les Hybrides des Orchidées tropicales", *La Nature*, Paris, November 15, 1935) describes the history of orchid culture since Neumann first succeeded in germinating the seed in 1844. Dominy, an assistant to James Veitch, was the first to hybridise two orchids (1856), and from that time, new hybrid plants have appeared in steady succession, until, at the present time, more than four hundred new kinds are described in most years. These hybrids are all fertile, and in some cases, seed can be produced parthenogenetically, following the mere stimulus of pollen upon the stigma. The account centres round the work of Noel Bernard, who introduced the symbiotic method of culture. Seeds were sown upon a sterilised medium which was then inoculated with a pure culture of a fungus, usually a species of *Rhizoctonia*. M. Costantin discountenances the asymbiotic method of culture, where seeds are grown on sterilised medium, containing glucose, with no added fungus. This is, perhaps, a little anomalous, for modern asymbiotic culture gives 100 per cent germination, and is used by all large orchid growers.

Horizontal Distortion of the Earth's Crust near Tokyo

IN the enclosure of the Tokyo Astronomical Observatory at Mitaka, five geodetic base-lines, each about 100 metres in length, are arranged so as to form a rhombus and its north-south diagonal. Once a year, on an average, since 1916, the lines have been measured, and the results show a relative increase or decrease in the area of the rhombus of the order 10^{-5}. The yearly variations have been discussed by Mr. C. Tsuboi (*Bull. Earthq. Res. Inst.*, 13, 558–561; 1935), and they are compared with those of the mean annual height of the sea-level at Aburatubo, a mareograph station about thirty-seven miles south of Mitaka. Though the latter variations are partly due to meteorological conditions over the adjoining sea, it is remarkable how similar are the curves representing the two variations, an increase in the area of the rhombus corresponding with an upheaval of the sea-coast. It thus seems probable, as Mr. Tsuboi concludes, that the changes in the area of the Mitaka rhombus are not of local origin, but correspond with larger crust-deformations prevailing over at least the southern half of the Kwanto district.

Flood Regimen of the River Garonne

IN a studiously analytical monograph on the regimen of the Garonne, reprinted from *La Revue Géographique des Pyrénées et du Sud-Ouest* (April–July 1935), M. Maurice Pardé, professor in the School of Hydraulic Engineering of the University of Grenoble, has made an important contribution to the literature on river characteristics and discharges. The Garonne floods, says Prof. Pardé, illustrate most vividly the complex character of the river. In no other fluvial basin in France, otherwise than exceptionally, do floods rise to so great heights. There exist, with several variations, three distinct types of inundation: Oceanic-Pyreneean, Oceanic-Classic and Mediterranean, as compared with a single type for the Seine and the Po, two types for the Loire, three for the Rhine and four for the Rhone. In reality, the flood system is more complex on the Garonne than on the Rhine, since the characteristics of the three types persist in intensity as far as the lower course of the river, while the 'Mediterranean' floods of the Rhine are absorbed in Lake Constance and the summer Alpine floods lose their violence below the Neckar. Alone in Europe, the Rhone and the Danube exhibit a variety of inundations comparable with those of the Garonne basin. The Oceanic-Pyreneean floods rank first in intensity, and occur at all seasons, though rarely in advanced summer or at the commencement of autumn (September, 1772). It is in May and June that they attain their greatest frequency and gravity. The main cause is heavy rainfall on the northern slopes of the Pyrenees and of the Montagne Noir, produced by winds from a north-west or northerly direction. The Oceanic-Classic type of flood, mostly deleterious

in the lower Garonne, occurs chiefly in winter; simultaneously with the Garonne, this type frequently afflicts several other important water-courses in western Europe, primarily the Dordogne, the Vienne and the lower Loire, then the Seine, the upper Rhone, the Meuse, the Rhine, etc. Such floods originate regularly in the passage of an atmospheric perturbation over France, while an anticyclone, essentially convex towards the north-east, is stationed on the south-west of the Iberian peninsula. The 'Mediterranean' type of flood is produced by torrential precipitation induced by the south-east wind in the eastern part of the basin. The severity of the Garonne inundations is remarkable.

Infra-Red Absorption of Crystals

R. B. BARNES, R. R. Brattain and F. Seitz (*Phys. Rev.*, Oct. 1) have elaborated a theory of the infra-red absorption of cubic crystals, and have tried to correlate it with new experimental work on MgO. On the classical theory, a cubic crystal has only one characteristic absorption frequency, corresponding to a vibration in which like ions move together and unlike ions 180° out of phase. The new theory handles the crystal as a system of interacting particles arranged on a lattice, and a general potential function of interaction is set up. The existence of anharmonic terms in the potential function is supposed to modify the selection rules in such a way that a complicated secondary structure is superposed on the single absorption frequency. The experiments were made on crystals of MgO prepared in the electric furnace on evaporated films and on powder. They show the existence of a secondary structure, but the low resolving power and the fact that the crystals were at room temperature, this causing broadening of the lines, make a detailed comparison with theory impossible. Further experiments are being carried out.

Quantum Theory, Geometry and Relativity

THE quantum theory, with its principle of uncertainty, seems to show that ordinary geometry is not applicable to microscopic space. In a series of interesting papers by T. Hosokawa, K. Morinaga, T. Sibata, Y. Mimura and T. Iwatsuki (*J. Sci. Hiroshima Univ.*, *A*, 5, 141, 151, 189 and 205; 1935), a new 'wave geometry' is discussed, which is chosen so as to conform with quantum theory. Its definitions are rather startling at first sight, as they are expressed in terms of matrices and a wave function which is a solution of a generalised Dirac wave equation. From these definitions an extensive theory is developed, more or less on the lines of the ordinary tensor calculus, giving results which are taken as the starting point of a new theory of relativity. It is claimed that this gives Einstein's law of gravitation in a natural manner. Another consequence of the new theory is the existence of gravitational waves, and equations are obtained which, it is hoped, will prove as useful in gravitational theory as are Maxwell's in ordinary electromagnetic theory. In short, the authors are attempting to go beyond the ordinary unified field theories, which leave out quantum theory, and to set up a universal scheme to embrace all physical theories. There are several points that have not yet been fully worked out, and it is too soon to say whether the attempt has been successful; but it certainly opens up what appears to be a very promising line of inquiry.

Diesel Fuel Research

RESEARCHES on Diesel fuels are being carried out by Prof. P. H. Schweitzer and T. B. Hetzel in the Pennsylvanian State College laboratories on oils for Diesel engines (Science Service, Washington, D.C.). The sources of petrol are continually diminishing, and unless it becomes possible to produce petrol cheaply from coal, we must anticipate to look forward to the day when motor-cars will be run with cheap Diesel fuels. Petrol 'knock' is due to the petrol starting to burn evenly in the cylinder, and then suddenly exploding, causing a 'knock'. For smooth running, it is necessary to retard the burning of the petrol, and this can be done by lead tetraethyl. In Diesel engines combustion is not started by sparking plugs but by spontaneous ignition due to the compression of the fuel, its temperature rising above that needed for explosion. If too much fuel explodes at once, there is a knock, and the way to stop it is to make the fuel burn as soon as possible after entering the cylinder, the remedy being to speed up combustion. Schweitzer and Hetzel have developed an ignition lag indicator which will be useful for testing the relative values of Diesel fuels. They employ the principle of a phonograph pick-up device in conjunction with a radio loud-speaker. The fuels are compared for performance over a wide range of compression values and the results found can be usefully applied in practice in special cases.

Preservation of Mine Timber

THE third of the series of Forest Products Research Records is entitled "Experiments on the Preservation of Mine Timber" by Messrs. J. Bryan and N. A. Richardson (H.M. Stationery Office, 1935). The timber used annually in the mines of Great Britain is valued at £6,000,000; it is estimated, however, that less than two per cent receives any preservative treatment. Losses are due to wood-destroying fungi. To some extent the reason why the non-expert is not so readily converted to the idea of preservative treatment is due to the fact that the incidence of attack is variable, some mines being quite free from infestation of this type. When conditions are favourable, such as in humid shallow pits, decay is very rapid, and the timber is short-lived if not treated with a preservative. The cost of timber is consequently high in such situations, and here preservative treatment would probably reduce running expenses of the pit. As is pointed out, the failure of mine timbers may often be due to incipient decay due to fungal attack, rather than to lack of individual strength. Thus preservative treatment may lead to greater safety in the mine. The note explains that experiments were inaugurated at two pits, the Langton Pit, Pinxton, near Nottingham, and the Woolmet Pit at Portobello near Edinburgh. The experiments were carried out with imported and home-grown Scots pine pit props which were treated at the pit-heads with solutions of sodium chloride (common salt), zinc chloride, sodium fluoride, Wolman salts, and placed in workings at about 800 ft. below the surface. In the Pinxton Collieries creosoted props were also used. The results attained so far after 4½–5 years inspection are considered satisfactory—the more expensive preservatives, namely, creosote, Wolman's salts and sodium fluoride, being the best.

Chemistry of the Vitamins

VITAMIN A

SINCE vitamin A has not yet been isolated, methods for the production of highly active concentrates are of interest. A method of comparing the richness in vitamin A of various products is the so-called 'blue value'. This is the number of blue units read with a Lovibond tintometer for 0·04 gm. of solid dissolved in anhydrous chloroform immediately after reaction with a solution of antimony trichloride in chloroform. Previous workers have prepared vitamin A concentrates by vacuum distillation, and very active materials had blue values of about 100,000—usually lower.

An adsorption method of concentration has now been investigated by H. N. Holmes, H. Cassidy, R. S. Manly and E. R. Hartzler[1]. The non-saponifiable portion of halibut liver oil was obtained in solution in pentane, the cholesterol and other impurities were frozen out by cooling for 7–10 days in a bath of solid carbon dioxide and alcohol, and filtered off under pressure, or by suction, through carbon dioxide snow. Solutions of 45,000–50,000, in one case 60,000, blue values were thus obtained. Filtration through an absorption column of Norit oxygen-freed charcoal, with special precautions to prevent oxidation, followed by a column of a new type of magnesia prepared from the precipitated hydroxide, gave blue values of 100,000–140,000, so that a concentrate of vitamin A at least 40 per cent more potent than any previously recorded was obtained.

VITAMIN B_1

By cleavage of vitamin B_1 with sulphite, a basic substance, C_6H_9NSO, is obtained as a colourless oil giving crystalline hydrochloride, chloroplatinate, picrate and picrolonate. E. R. Buchman, R. R. Williams and J. C. Keresztesy[2] now find that this substance gives on oxidation an acid with the formula $C_4H_4NS.COOH$, which is identical with one obtained by Windaus directly from the vitamin. The basic substance is regarded as a tertiary heterocyclic base with a β-hydroxyethyl side chain, $C_4H_4NS.CH_2CH_2OH$, and the vitamin itself as a quaternary salt of the base.

The presence of a quaternary nitrogen in the vitamin B_1 has been confirmed by electrometric titration with alkali by R. R. Williams and A. E. Ruehle[3], when the presence of a moderately strong basic nitrogen was revealed, too strong for a tertiary base, but not strong enough for a true quaternary base. The basic cleavage product, C_6H_9NSO, behaved as a typical tertiary base, but its methiodide closely resembled the vitamin not only in basic strength but also in exhibiting an unusual pseudo-basic behaviour, both substances requiring an additional equivalent of alkali for complete liberation of the base.

It had been suggested that the vitamin contains a thiazole nucleus, and titrations of some thiazole derivatives gave similar results. The conclusion is reached that vitamin B_1 contains two basic groups, one of which is of the same order of strength as the nitrogen in the quaternary salt of its basic cleavage product and in 4-methylthiazole ethiodide. This feature of the structural formula for vitamin B proposed by Williams[4] is thus confirmed.

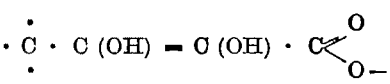
In view of the presence of sulphur in the vitamin B_1 molecule, and the suggestion that it contains a thiazole nucleus, it was obviously of interest to examine the mode of combination of the sulphur by methods recently developed for the study of sulphur in proteins, especially the behaviour towards alkali plumbite and bromine water. The vitamin B_1 and its basic cleavage product behaved very differently with both reagents, according to H. T. Clarke and S. Gurin[5], the vitamin giving lead sulphide relatively rapidly with plumbite reagent and the cleavage product scarcely reacting, and the latter is largely oxidised to sulphuric acid by bromine water under conditions in which the vitamin remains almost unchanged.

These results indicate that the sulphur atom in the base is linked to two carbon atoms in a structure in which the carbon groupings are more susceptible to oxidative attack than is sulphur. The acid obtained by Windaus, $C_5H_5O_2NS$ (see above), yields lead sulphide with plumbite, yet is resistant to oxidation with nitric acid. This is characteristic of the thiazole nucleus, and it is now shown, by synthesis, that the acid is 4-methylthiazole 5-carboxylic acid. The basic cleavage product is shown to be 4-methyl 5-β-hydroxyethylthiazole, which has been synthesised. Titrations of vitamin hydrochloride and of 4-methyl thiazole ethiodide indicate that the last of the three equivalents of alkali used, reacting about *p*H9, opens the thiazole ring with formation of a sulphydryl compound.

Examination of absorption spectra by A. E. Ruehle[6] shows that the ultra-violet absorption of the basic cleavage product of vitamin B_1 is not only similar to that of the thiazoles, but its derivatives also exhibit absorption similar to that of corresponding thiazole derivatives.

VITAMIN C

The titration curves and dissociation constants of *l*-ascorbic acid (vitamin C) were determined by Birch and Harris[7], who found at 16°–18° the values $pK_{a_1} = 4{\cdot}17$ and $pK_{a_2} = 11{\cdot}57$. A determination at 22°–23° by W. D. Kumler and T. C. Daniels[8] is now shown to give the values $pK_{a_1} = 4{\cdot}12$ and $pK_{a_2} = 11{\cdot}51$, in very good agreement. The hydrogen electrode was used. Titration curves for *l*-ascorbic acid and diethyl dihydroxymaleate in alcohol water solution were also determined, in view of the suggested formula for *l*-ascorbic acid in which this compound has no carboxyl group, but contains a grouping



Evidence that a structure of this type may give rise to relatively strong acid properties has been cited.

The β-ketonic ester, diethyldihydroxymaleate, contains this structure, and a consideration of its groups shows that it should be a stronger acid than *l*-ascorbic acid. Actually *l*-ascorbic acid is much

stronger, its first dissociation constant being a thousand times as great as that of the other compound. The apparent inability of the enolised α-hydroxy-β-ketonic ester type of compound to account for the acid properties of *l*-ascorbic acid suggests that some other grouping is responsible for its large first dissociation constant. It may, however, be suggested that the use of the ordinary hydrogen electrode with a compound containing a double bond requires further investigation.

[1] *J. Amer Chem Soc*, **57**, 1990; 1935.
[2] *J. Amer. Chem. Soc*, **57**, 1849; 1935.
[3] *J. Amer. Chem. Soc.*, **57**, 1856; 1935.
[4] *J. Amer Chem Soc.*, **57**, 229; 1935.
[5] *J. Amer. Chem. Soc.*, **57**, 1876; 1935.
[6] *J. Amer. Chem. Soc.*, **57**, 1887; 1935
[7] *Biochem. J.*, **27**, 595; 1933
[8] *J. Amer. Chem. Soc.*, **57**, 1929; 1935

Fire Resistance of Buildings

A LABORATORY of an unusual kind was opened by H.R.H. the Duke of Kent at the end of last month. This is the Fire Testing Station erected at Elstree by the Fire Offices Committee, an organisation representing the tariff insurance companies, for the purpose of investigating the resistance to fire of building materials and elements of structure.

The need of such an institution has been apparent for some years, and has been steadily growing. Little enough is known of the protection against fire afforded by the traditional types of building material, and still less of the many new types which have appeared in recent years. This uncertainty is reflected in the building codes issued by local authorities, which, so far as provisions against fire are concerned, are often contradictory.

A good deal of research has been carried out abroad, notably at the Underwriters Laboratory at Chicago; and in Great Britain, before and during the Great War, the now defunct British Fire Prevention Committee investigated certain aspects of the problem. But the first attempt in Great Britain to put the whole subject on a sound basis was taken by the British Standards Institution in 1932. In this year, it published "Definitions for the Fire Resistance, Incombustibility and Non-Inflammability of Building Materials and Structures" (B.S.S. No. 476), which laid down a test procedure for assessing the fire resistance of structural elements by means of a standard test upon full-sized specimens.

From the evidence of actual fires and from demonstration tests, it has been established that the temperature within a fiercely burning building rises rapidly to about 1,500° F. and thereafter more slowly up to a maximum of about 2,000° F. The standard test provides that specimens shall be heated in accordance with a time-temperature curve which approximates to that of recorded conflagrations; furnace temperatures of 1,000° F., 1,700° F. and 2,300° F. are required at the expiration of 5 minutes, 1 hour and 8 hours respectively from the beginning of the test. It is also necessary to take account of the effect of water from fire hoses impinging on a heated structure. The specification therefore requires that immediately following the period of heating the specimen shall be subjected to a jet from a fire hose applied under standardised conditions for a period equal to one minute for each hour of fire exposure. In the case of load-bearing structures, it is further provided that a load equal to 1½ times the working load shall be maintained on the specimen throughout the whole period of the test. In certain cases, the load must be re-applied forty-eight hours after the completion of firing.

According to the period which elapses between the beginning of the test and the failure of the specimen, the specimen is classified into one of five grades, the highest being represented by a fire-resistance period of six hours and the lowest by one of half an hour.

In the case of walls, floors and other elements which function as separating structures, the specimen is heated on one side only, and failure is indicated either by a temperature rise on the unexposed face of more than 250° F., or by the development of cracks through which flame can pass, or by collapse under load. Columns and other elements which serve only as load bearers are heated on all sides and are said to have failed when collapse under load occurs.

By issuing this specification, the British Standards Institution not only provided a clear basis for the study of the subject, but also directed attention to the absence of adequate testing facilities. As a result of a conference between interested bodies, the Fire Offices Committee undertook to provide these facilities and the Department of Scientific and Industrial Research to assist in the solution of technical problems.

The Testing Station at Elstree consists of two buildings: one contains equipment for testing the fire-resistance of structural elements; in the other, provision is made for continuing the work on sprinklers, fire-extinguishers and other appliances which has hitherto been carried out by the Committee at Manchester. For testing structural elements, three units have been provided—for walls, columns and floors respectively. In each case, heat is provided by a gas-burning furnace operated electrically from a control room adjoining and overlooking the main building. The gas-air mixture is fed to the burners through 'inspirators' which automatically maintain a constant proportion of the two ingredients at all pressures; the air is supplied at a maximum pressure of approximately 15 in. of water and the gas at the normal pressure of the mains. The fuel supplied to different parts of the furnace is controlled separately, with the view of maintaining a uniform temperature over the whole area of the specimen.

Both furnace and specimen temperatures are recorded by thermocouples connected to instruments located in the control room. Platinum rhodium–platinum couples are used for furnace temperatures, and chromel–alumel or copper–constantan couples for specimen temperatures. The leads from each separate equipment pass through a bus-board mounted on the instrument panel, by means of which a quick change-over may be effected from one furnace to another.

In the wall and column units, the load is applied to the specimen by mounting it in a heavy, built-up steel frame designed so that an upward thrust can be given to the bottom beam of the frame by means of hydraulic rams. The rams are operated on a maximum oil pressure of two tons per square inch, the oil being supplied by an electric pump and the load being recorded by a pendulum dynamometer in the control room. These loading frames have a maximum capacity of 500 tons. They stand in pits in the floor of the building, and the furnaces used in conjunction with them are built on wheels so that they can be moved away for the water test. In the floor testing unit, the furnace is fixed and the specimen is lifted away for the water test by a 30-ton travelling electric crane.

The essential aim of the Station is to provide the means of carrying out tests, as rapidly and economically as possible, on the basis of the standard specification. A considerable amount of work upon traditional materials is required, but tests of new types will be run concurrently.

Arrangements have been made whereby the facilities of the Station will be available to the Department of Scientific and Industrial Research, through its Building Research Station, both for carrying out a general programme of research into the fire resistance of traditional materials, and for conducting tests on behalf of manufacturers in accordance with a fixed schedule of charges, when a certificate of performance is required. It is hoped that the industry will take full advantage of the opportunity which now occurs to have the fire-resisting properties of its products assessed on a proper basis.

Scientific Research in Transport

NEW LABORATORY OF THE LONDON, MIDLAND AND SCOTTISH RAILWAY

LORD RUTHERFORD opened the new research laboratory at Derby of the L.M.S. Railway on December 10 (see NATURE, December 14, p. 949).

A distinguished party of guests travelled from St. Pancras by special train, the engine of which was named "Lord Rutherford of Nelson" by Lord Rutherford's small grandson, Pat Fowler, and at Derby luncheon was served on the train. Speeches made during luncheon by Sir Josiah Stamp and Lord Rutherford were relayed to the various cars, and everyone heard excellently. In his speech, the former specially welcomed Sir William Bragg and Sir James Jeans. He recalled that when he was president of the Institute of Transport, he devoted his presidential address to the subject of scientific research in transport and expressed his gratification that some of his dreams have now come true. The days of haphazard and rule of thumb tests are over; the days of controlled and directed experiment under arranged conditions have fully arrived. At the same time, he said, "I would like to stress the fact that we are not trying in this new laboratory to supersede or to rival scientific effort in all directions". The company is still extending its use of outside facilities in connexion with the Department of Scientific and Industrial Research.

Lord Rutherford, in declaring the new laboratory open, said that the L.M.S. is described as a public utility company; but it is more like a State within a State, as it has a gross revenue of nearly seventy millions and its own sea, land and air forces all organised for the most efficient service to the community. On the map, the railway appears to be not merely the backbone but rather the whole vertebrate system of Great Britain. Lord Rutherford said he is convinced that there is scarcely a single unit, whether of machinery or lay-out or even of organisation, that cannot be improved for its purpose by the application of scientific research. But even when valuable results are obtained, there still remains the serious difficulty of introducing them into this great organisation, which has developed over long years a successful routine. To obtain the best results from a laboratory such as the one at Derby, it is essential to develop mutual respect and understanding between the scientific man and the practical man. He expressed the hope that the officers and staff of the Railway will take the greatest interest in the new laboratory and utilise its services to help solve their problems.

Lord Rutherford then declared the laboratory open, and the staff and visitors were divided into groups and shown over it, some of them also inspecting the wagon and locomotive works.

The L.M.S. Railway is probably the largest commercial undertaking in the world. It has an authorised capital of 439 million pounds and gives employment to 223,000 persons. In addition to 7,000 miles of line open to traffic, it possesses 8,000 locomotives, hundreds of thousands of vehicles, 45 steamers and 31 hotels. In addition, it conducts several extensive manufacturing undertakings in connexion with its transport business. In 1930, Sir Harold Hartley was appointed vice-president and director of scientific research. In 1932, the chemical, paint, metallurgical and textile laboratories were formed into a research department. The effect of the completion of the new laboratory is to concentrate in one building the various research sections. In addition to possessing a large staff of specialists to deal with the various problems which are continually arising, the department utilises to the fullest extent the research organisation of the Department of Scientific and Industrial Research. It is also a member of six research associations, and allocates certain problems to research laboratories at the universities.

The Metallurgical Section is concerned with investigations relating to the selection of metals and their manipulation by casting, forging, heat treatment and welding. It also examines materials which have failed to give a satisfactory performance in service. The Engineering Section deals with research on the design and performance of engineering details of machines and structures. It studies aerodynamical problems connected with the air resistance of trains, with wind pressures, ventilation systems and so on. The Textile Section is responsible for the inspection and testing of the various textile materials purchased by the Company, and for drawing up specifications

controlling their quality. This laboratory makes about eight thousand tests every year. The Paint Section specifies and tests all kind of paint materials. It is also concerned with the routine control of the manufacture of paint- and varnish-cleaning agents. In the constant-temperature and humidity room the nature of all textiles is closely examined. A humidity control apparatus maintains constant conditions of 75° F. and 66 per cent relative humidity. This is essential, as the properties of textiles vary largely with temperature and humidity.

In the workshop, special precautions have been taken to prevent the transmission of vibration. In some of the rooms accelerated tests are carried out. For example, in the paint exposure laboratory, by the use of the 'weatherometer', results can be obtained in five weeks which with outdoor exposure alone would have taken twelve months. At the moment, more than a thousand outdoor exposures are in progress. Visitors were impressed by the practical nature of the tests, and the great economic value of the results to the Company.

Energy-Output of the Coal-Miner

IN a paper read before the Institution of Civil Engineers on December 13, Prof. Kenneth N. Moss discussed the energy-output of the coal miner.

The object of the first part of the paper was to show that the performance of manual work necessitates a food-input in excess of the energy-output. Thus if it is required to maintain a high work-output from men engaged in manual work, the engineer in charge must satisfy himself that the calorie-value of their food-input is adequate for the purpose.

Some years ago, Prof. Moss determined the calorie-value of the daily food-input of sixty colliers, and found that the average was a little more than 4,700 Cal. The average oxygen consumption per minute throughout the working shift on the coal-face for twelve colliers was found to be 1,333 c.c., which, after deducting the average oxygen basal resting-rate of 235 c.c. of oxygen a minute, was found to be equivalent to 16,950 ft.-lb. of energy.

The total energy expended below ground during a 7½-hour shift is about 2,800 Cal., and the energy expended during 24 hours is estimated to be about 4,500 Cal. Thus the calorie-value of the daily food-input of a miner should be 4,750–5,000 Cal., to enable him to do his work without loss of body weight or coal-output. The actual average work-output, assuming the mechanical efficiency of the body to be 25 per cent, was 4,237 ft.-lb. per min. during the time spent on the coal-face.

If a miner has to work or walk in places where he has to stoop a good deal, his energy-output is greatly increased, or in other words, the mechanical efficiency of his body is seriously diminished. Thus if a miner has to work in a stooping position so that his body height is reduced by 40 per cent, his energy-output is increased by 65 per cent. If men have to walk a good distance along low roadways the energy expended may be so great as seriously to affect their work-output in the working place. Alternatively, if men are called upon to walk to their work under such conditions, their food-intake must be increased to enable the extra energy to be expended.

Referring to the physiological aspect of the problem, Prof. Moss said that a miner at work in air at a dry-bulb temperature of 98°–100° F., and a wet-bulb temperature of 85° F., can lose as much as 18·56 lb. of moisture through the sweat-glands and respiratory tract during 5½ hours work. If the work-output below ground is equal to 2,800 Cal., it is necessary, assuming that no heat is lost by radiation and conduction, to evaporate 10·6 lb. of water from the skin to neutralise the heat generated in the body during work. The significance of a high wet-bulb temperature is thus clear.

The drinking of water when at work is essential in order to keep the body-temperature normal, though excessive drinking of water is harmful. The significance of the chloride content of the blood points to an effective remedy for heat-cramp and fatigue; the addition of 5–10 gm. of sodium chloride to 1 gallon of drinking water will prevent the cramp, and to a great extent the fatigue, which is caused by hard work under trying air-temperature conditions.

Archæological Research in South Africa

ONE of the biggest drawbacks to the proper study of prehistoric archæology in South Africa has been, and still is, the complete absence of a properly worked out and correlated geological background. The advances and recessions of ice sheets during the Quaternary provide this background in Europe, and broadly speaking, the existence of the geological canvas has not only created a great stimulus to research in prehistory generally, but has actually become an essential feature of the proper study of the subject. In South Africa there is unfortunately no such background. Prehistorians will therefore be interested to know that the Directors of the Geological Survey and the Bureau of Archæology of the Union of South Africa have arranged a joint and detailed geological and archæological survey of certain vital sections of the Vaal and Riet River Valleys and their tributaries, with special reference to climatic and other conditions during the Quaternary. These valleys hold the secrets of climatic fluctuations and earth movements that were experienced in post-Pliocene times in South Africa, secrets that may be found to be intimately interrelated with climatic fluctuations and movements in other parts of the world—in East Africa and Europe particularly. If correlation is possible and earth

movements and 'pluvial' and interpluvial conditions here can be satisfactorily correlated with similar conditions in East and Central Africa and with glacial and interglacial conditions in palæarctic regions, we must ultimately be led to a better, if not a proper appreciation of the relative time horizons when men practising similar material cultures appeared on the scene in these continental extremes. The issue is of the greatest moment in that men who made Chelles-like tools are believed to have appeared in Southern Africa during early Pleistocene times, and this new undertaking, sponsored entirely by the State and under strict control, therefore represents the greatest step forward prehistory has known for some time.

The sequence of prehistoric material cultures in South Africa is too well known to need recapitulation here. From the Stellenbosch Culture (Chelles + Clacton types to Acheul + Old Levallois types) through the Fauresmith Culture (La Micoque + Combe Capelle + Levallois types) upwards, the story is complete. All we need is the geological and particularly the climatological background.

Ancient river terraces, stratification and its causes, associated fauna, alluvial deposits, etc., will be examined by geologists and archæologists working in the closest harmony over several hundred square miles, and it is confidently anticipated that this work will lay the foundation for a better, if not a full appreciation of the geological and climatological canvas on which all our pictures of prehistoric man in South Africa must be drawn. This work should undoubtedly lead us to a better appreciation of possible and more far-reaching correlations with climatic fluctuations and earth movements in other parts of the world, and so to the relative dating of the appearance of particular lithicultural horizons in widely separated areas.

The value of the Vaal River was recently brought out by Prof. Van Riet Lowe, director of the Bureau of Archæology, in the article "Implementiferous Gravels of the Vaal River at Riverview Estates" in NATURE of July 13, 1935 (pp. 53–56). Similar conditions, Prof. Van Riet Lowe assures us, exist over many hundreds of miles along this amazingly rich valley.

The areas to be attacked immediately are those that will be inundated after the completion of the huge dams at present in course of erection at various sections across these rivers.

Fieldwork is being started immediately, and it is anticipated that it will continue for at least eight months. Two geologists and an archæologist are taking the field at once. The major issue is undoubtedly geological and this side of the problem is therefore being stressed.

Study of Nutrition

INQUIRY BY LEAGUE OF NATIONS EXPERTS

THE Expert Commission on Nutrition appointed by the Health Committee of the League of Nations met on November 25 at the London School of Hygiene and Tropical Medicine. Those present were:

France: Prof. L. Alquier, director of the Institut d'Hygiene Alimentaire, Paris; Prof. L. Lapicque, professor of physiology at the Laboratory of Physiology, Sorbonne, Paris.
Scandinavia: Dr. Axel Hojer, Generaldirektor, Medicinalstyrelsen, Vallingatan 2, Stockholm.
United Kingdom: Prof. E. P. Cathcart, professor of physiology, University of Glasgow; Prof. E. Mellanby, secretary of the Medical Research Council, London; Sir John Boyd Orr, director of the Imperial Bureau of Animal Nutrition, Reid Library, Rowett Institute, Aberdeen.
United States: Prof. E. V. McCollum, professor of biochemistry, Johns Hopkins University, Baltimore; Dr. Mary Schwartz Rose, Columbia University, New York; Dr. W. Sebrell, chief of the Department of Nutrition, National Institute of Hygiene, Washington, D.C.
U.S.S.R.: Prof. Sbarsky, director of the Central Nutrition Institute, Moscow.

Two other members of the Commission, namely, Prof. Durig of Vienna, and Prof. Schiotz of Oslo, were unable to attend the meeting.

The Commission elected Prof. Mellanby as chairman and Dr. McCollum as vice-chairman.

A statement was presented on the origin of the studies of the question made under the auspices of the League of Nations. After a general exchange of views, the Commission decided to draft a statement on scientific principles governing dietaries of certain population groups—namely, women during pregnancy and lactation, infants, school-children, and adolescents up to the age of twenty-one years.

Two sub-committees—one on energy-producing substances, under the chairmanship of Prof. Cathcart (members: Profs. Alquier, Lapicque, Sbarsky and Sebrell); and the other on non-energy-producing substances (such as mineral salts, vitamins, etc.), under the chairmanship of Prof. McCollum (members: Profs. Höjer and Mellanby, Sir John Boyd Orr and Dr. Schwartz Rose, with Dr. Harriette Chick of the Lister Institute as secretary)—were entrusted with the task of drawing up detailed recommendations to be submitted to the plenary commission at a later meeting.

In the course of the week, each of these committees drew up its own report, and from them a combined report covering the whole subject was drafted and, after due consideration, adopted unanimously. This report is now being printed at Geneva in English and French, and will be published in the near future. It will undoubtedly arouse great interest among those concerned, both from the scientific and social aspects of nutrition. The report of this Commission of Experts on Nutrition will then be sent on to a mixed committee which includes economists and experts in agriculture as well as representatives of the present Commission. Prof. Mellanby and Prof.

McCollum were appointed representatives on this mixed committee, with Sir John Orr and Dr. Mary Schwartz Rose as substitutes. This mixed committee will meet in February 1936 at Geneva.

The modern knowledge of nutrition being still in the stage of development, the Commission had to consider future progress. It drew up a list, in order of priority, of the problems for future study at various scientific institutes already engaged on similar lines of research, with a view to practical progress.

Educational Topics and Events

CAMBRIDGE.—The Lowndean professorship of astronomy and geometry will become vacant by the retirement of Dr. H. F. Baker on September 30, 1936. A meeting of the electors will be held on January 31, 1936. The General Board has recommended and the Council of the Senate has determined, that at this election preference shall be given to candidates whose work is connected with geometry in the widest modern sense. Candidates for the professorship are requested to communicate with the Vice-Chancellor and to send him, on or before January 14, 1936, ten copies of any statement or testimonial which they desire to submit to the electors.

It is recommended by the Faculty Board of Engineering that J. A. G. Haslam, of Corpus Christi College, be appointed assistant in research in the Sub-Department of Aeronautics with a stipend of £500 a year, made up of £300 from the University grant and £200 from Sir John Siddeley's gift for aeronautical research.

SHEFFIELD.—The title of honorary lecturer in physics has been conferred on Dr. W. H. George, Sorby research fellow.

Mr. H. T. Protheroe has been appointed assistant lecturer in metallurgy (founding).

The Rockefeller Foundation, New York, has made a grant of £200 in aid of research in the Department of Pharmacology.

THE annual report of the Yorkshire West Riding County Council on the county minor scholarships examinations, recently issued, records an important advance in the employment of intelligence tests. For the last three years, while an intelligence test has been *taken* by all candidates, it has been *used* only as a means of differentiating the border-line cases. This year it has been taken into account in all cases except those where low marks in English and arithmetic precluded the possibility of awarding a scholarship. One effect has been to give the chance of a scholarship to candidates obtaining a high 'intelligence quotient' whose marks in arithmetic and English would not last year have been high enough to bring them within the range of the border-line. The examiners believe that, as a result of the employment of the test, awards have been made only to those candidates who have the necessary ability and educational background to enable them to profit by a secondary school education. Special attention was directed last year to the widely prevalent fault of reading the questions carelessly and of introducing irrelevant matter into the answers. This fault was much less conspicuous this year.

Science News a Century Ago

The Elephant House at the Zoological Gardens

IN the issue of *The Times* of Christmas Day, 1835, is a note on the Zoological Gardens from a correspondent who says: "The elephant has taken possession of the new house which has been prepared for his reception, and he now enjoys the society of the young female of his order presented by His Majesty. The house is by far the best building in the gardens, and is every way worthy of so great a personage. There is a mode of heating it adopted which we understand is perfectly original and seems likely to supersede all other methods in use in warming churches, chapels, and all buildings having incombustible floors. The simplicity of the plan is as remarkable as it is apparently effective and unexceptional. . . . The fuel used is inconceivably small, and the cheapness, simplicity and safety of this new method of heating cannot fail to engage the attention of all scientific and practical men."

A Christmas Experiment in Magnetism

FARADAY notes in his Diary an experiment, made on the day after Christmas 1835, on "the possibility that some metals, not magnetic at common temperatures, might become so at low temperatures". He must have been occupied at the time with preparations for the Juvenile Lectures, for he gave the Christmas course of 1835–36 on electricity; but the day was a very cold one, for he records the temperature as 25° F.; and neither Christmas festivities nor lecture preparations could induce him to forgo so favourable an opportunity. The apparatus was carried up to the roof of the lecture theatre and there, where the fullest advantage of the low out-of-doors temperature could be taken, the experiment was made.

He had a magnetometer with a delicate astatic needle: "This kind of needle was used as the most delicate test". Some wires of various metals were tied up in little bundles with platinum wire. "Then cooled these bundles in liquid sulphurous acid, in watch glasses containing a little mercury also, and when below the freezing point of the mercury, brought them close to the ends of the astatic needle to ascertain if they had become sensibly magnetic; but could not observe the least indication of such an effect, though I think the temperature must occasionally have been 60° or 70° below Zero of Fahrenheit".

New Classification of Animals

ON December 26, 1835, the *Athenæum* stated: "M. de Humboldt has presented to the French Academy of Sciences, in the name of M. Ehrenberg, correspondent of the Academy in Berlin, a table dividing the animal kingdom into 29 classes. This division is founded on the organisation and generality of a type, lying in the sensitive, vascular, locomotive, nutritive, and propagative systems. Twenty-two of the groups belong to animals without vertebræ, which are divided according to the presence or absence of a heart, Cordata and Vasculosa. In the latter, the vessels do not present anything like pulsation, and the digestive organ is either simple and solitary, as in the Tubulata, or divided and multiform, as in

the Racemosa. In the course of his travels in Syria, Nubia, Dongola, the Red and Caspian Seas, etc., M. Ehrenberg has had an opportunity of examining a number of organised beings, and has continued his microscopic researches since that period; but he only offers his table as a sketch capable of perfection, and successive developments."

Christian Gottfried Ehrenberg was born in 1795 and died in 1876. His first travels, lasting from 1820 until 1826, were made with Hemprich, and it was in 1829 that he set out with Humboldt to visit the Ural and Altai mountains. His great work "Infusionsthierchen" appeared in 1838.

Goodyear and India Rubber Manufacture

QUOTING from the *New York Journal of Commerce*, the *Mechanics' Magazine* of December 26, 1835, said: "A discovery has recently been made by Mr. C. Goodyear, by which India-rubber, after having been dissolved, can be restored by a cheap process to its original whiteness, and the pure grain formed into a fabric to be used instead of cloth, leather or parchment, and can be moulded into almost any form; and can also be combined in a variety of ways with cloth, cordage or leather. Being first made white, it admits of every shade of colour, worked in, and as durable as the rubber itself. A variety of fine specimens are now being exhibited at the Mechanics' Institute at Castle Garden, which will give an idea of the general utility of the invention."

Charles Goodyear (1800–60) first turned his attention to rubber in 1834. His work of 1835 was only partially successful, but four years later he accidentally discovered the process of vulcanising. He has been called "the Palissy of the rubber industry".

Societies and Academies

LONDON

Royal Society, December 12. F. C. COURTICE and C. G. DOUGLAS: The effects of prolonged exercise on metabolism. In the normal postabsorptive subject, there is a striking fall of the respiratory quotient during rest subsequent to work which may last for hours. This is accompanied by ketosis and a progressive slow fall in the carbon dioxide combining power of the blood. Ketosis can readily be prevented by taking a carbohydrate rich diet on the previous day, but still occurred with great frequency when either an ordinary breakfast or a quantity of sugar was ingested shortly before beginning the experiment, the main effect in the latter case being apparently increased utilisation of carbohydrate during the work. The fall of respiratory quotient is attributed mainly to a reduction of the ratio of carbohydrate to fat oxidised owing to depletion of stores of available carbohydrate during the work, but in addition there may be some conversion of fat into stored glycogen, though only to a small extent. During post-exercise rest there is reduced sugar tolerance, and the possible influence of endocrine secretions on carbohydrate metabolism during muscular work is discussed. W. L. FRANCIS: The surface membranes of muscle fibres. Using Osterhout's methods as a guide, the following results have been obtained. The *p*H of fresh muscle brei is found with a quinhydrone electrode to be 7·1, in agreement with estimates by other workers of the *p*H of resting living muscle. The *p*H after 24 hours is 6·7. The composition of an aqueous solution resembling brei in its inorganic content is discussed. The stumbling block is the phosphate, which can only be made 1/5 as concentrated in aqueous solution as in the muscle fibre. The diffusion potentials between brei and various electrolyte solutions were measured. They point to the mobility of anions being very low in brei compared with their mobilities in aqueous solution. The vapour pressure of brei is found by Barger's method to be equivalent to 1·06 per cent sodium chloride. The effects of cut muscle, brei and various experimental solutions on the resting potential are investigated with the view of finding what the 'asymmetry' potential of the surface membrane would be if the media on both sides were the same. The value would be 10–20 mv. reckoned inwards. The diffusing substance need only saturate the interfibrillary spaces in order to produce its full effect on the potential at the fibre surface.

PARIS

Academy of Sciences, November 18 (*C.R.*, 201, 917–996). ABRAHAM WALD: The curvature of surfaces. P. RACHEVSKY: A dual metric geometry, based on generalised Cartan spaces. A. KHARADZÉ: A functional operator and the generalisation of Legendre polynomials. GEORGES GIRAUD: Problems of the type of Dirichlet and Neumann in certain cases where the data are discontinuous. PIERRE BOOS: The characteristic properties of certain analytical surfaces. PAUL FLAMANT: Two functions attached to a function capable of summation, and their application to the limit of Lebesque integrals. F. LEJA: A harmonic function connected with any closed ensemble of points of space. LÉON BESCHKINE: The equations of equilibrium of thin surfaces. ANTOINE MAGNAN and CLAUDE MAGNAN: Making evident small differences of the refractive index in liquid media. Application to the study of the movements of water such as that produced by the motion of a fish. The apparatus records the motion of the water on a kinematograph: six photographs are reproduced. PIERRE ERNEST MERCIER: The characteristic functions of a cantilever wing (resistance in bending). JACQUES VALENSI: Study of the flow of air round the wing of an aeroplane: marginal phenomena. Results obtained by a photographic method: two photographs are reproduced. DANIEL BARBIER: The colour temperatures of the stars. PAUL SOLEILLET: The coherence of vibrations in optical resonance. JEAN ROULLEAU: The determination of the contact resistance metal – cuprous oxide. JEAN MERCIER: Contribution to the study of the synchronisation of oscillators. CHARLES DEGARD: The diffraction of electrons by chloroform, and the structure of the molecule: the Urbain model and the tetrahedral model. The Urbain formula (the co-ordinative formula $CCl_4.HCl$) and the usual tetrahedral $CHCl_3$ both agree with the experimental results. Experiments on electronic diffraction cannot decide between the two formulæ. PIERRE JACQUET: The practically instantaneous action of certain colloids on the electrolytic deposit of copper. During the electrolysis of copper sulphate solutions, it was found that only the proteins (gelatine, serum albumin) have a marked action during the first moments of electrolysis: the gums act much more slowly. HENRI BIZETTE and TSAÏ BELLING: The magnetic double

refraction of nitric oxide. Experimental results obtained with the large electromagnet of the Academy of Sciences, the nitric oxide being under pressures of 80 and 100 atmospheres. MLLE. ARLETTE TOURNAIRE and ETIENNE VASSY: The continuous spectrum of deuterium. Comparisons of the spectra of deuterium and hydrogen show slight differences. The curves of the two gases coincide at about 4000 A., and then deviate very slightly as the wave-length diminishes. The continuous spectrum of deuterium is a little more intense than that of hydrogen. PAUL GOLDFINGER, WLADIMIR LASAREFF and BORIS ROSEN: The energy of dissociation of carbon monoxide. Among the different possibilities deduced from the CO spectrum, only the value for the dissociation energy 9·1 v.e., giving 123·6 kcal. for the heat of sublimation of carbon at 0° K., is not in contradiction with the thermo-chemical and spectroscopic data. LÉON GUILLET, JR.: The modulus of elasticity of the copper – beryllium alloys. Beryllium increases the modulus of elasticity of copper: the alloy with 15 per cent of beryllium has a modulus equal to that of steel. MARCEL PRETTRE: The influence of the gases adsorbed by the wall of the vessel on the chain reaction of mixtures of hydrogen and oxygen. JEAN AMIEL: Some organic cupritetrachlorides and cupritetrabromides. JEAN LOISELEUR: The formation of protein thioderivatives with the aid of carbon disulphide. Carbon disulphide transforms casein, gelatine and egg albumin into thio derivatives, probably by forming thiosulphocarbamic groups with certain amine groups. These substances are soluble in organic solvents. YVES VOLMAR and BJÖRGE HANSEN: The alcoholysis of olive oil. By fractional distillation under pressures below 1 mm., methyl palmitate, oleate and methyl arachidate were isolated. ALFRED SILBERSTEIN: The crystalline parameters of the double bromide of copper and ammonium. This double salt, like the corresponding chloride, is quadratic. The parameters resulting from an X-ray study are given. JACQUES BOURCART: The quaternary in the Meknès (Morocco) district. SIVASUNDEN DEB: The discovery of nummulites in the nummulitic grits of the Alpes-Maritimes, and on the origin of this series of strata. G. DENIZOT: The distribution of the lower alluvia in the Loire valley. FRANCK BOURDIER: The stratigraphy of the quaternary ante-Wurmian alluvia of the Grésivaudan and of the Chambéry valley. RAYMOND DECARY: The Mahajamba River of Madagascar and its temporary captures by the Kamoro. Details of the five changes of course of this river since 1864, conditioned by changes in the rainfall in this region. DENIS BACH and JEAN FOURNIER: The assimilation of oxalic acid by *Aspergillus niger*. ANDRÉ BOIVIN, MAX MARBE, MME. LYDIA MESROBEANU and PETRE JUSTER: The existence in *Bacillus tumefaciens* of an endotoxin capable of causing the formation of tumours in plants. JOSEPH MAGROU: The immunity and hypersensibility of the *Pelargonium* towards reinfections by *Bacterium tumefaciens*. J. ANDRÉ THOMAS: A new mode of direct cellular multiplication. Meroamitosis. PIERRE LESNE: Certain faunistic relations between Madagascar and south-eastern Africa. LÉON BINET and G. WELLER: The liver and glutathione. JACQUES PARROD: The formation of hydrocyanic acid, starting with some organic compounds, in the presence of ammoniacal copper sulphate. This appears to be a general property of reducing sugars. Carbon monoxide and formaldehyde give no hydrocyanic acid under the same conditions.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 4; 1935). P. K. RASHEVSKIJ: Metric duality in Finsler's two-dimensional geometry, particularly on an arbitrary surface. J. SEKERZH-ZENKOVICH: On the theory of currents. V. M. CHULANOVSKIJ: The rotation structure of the nitrogen molecule in the Schumann region. S. A. ARZYBYSHEV: Note on the paper "On the electrolysis of copper in rock salt" (*C.R. Acad. Sci.*, 4, 25; 1934). A. ZHUCHOVICKIJ: A new method of solution of variation problems of quantum mechanics. N. A. PREOBRAZHENSKIJ, A. M. POLIAKOVA and V. A. PREOBRAZHENSKIJ: Alkaloids of the leaves of jaborandi (6). Synthesis of racemic homopilopic acid. M. M. KATZNELSON and M. I. KABACHNIK: Amination with sodium and potassium amides. (4) Nitration of α-amino-anabasine. A. E. FERSMAN: The periodic system of energy coefficients. V. A. DEVIATNIN and V. M. DOROSHENKO: A chemical method for determining vitamin C. F. LOEWINSON-LESSING: The chemical composition of tectites. A. M. DJAKONOV: New Ophiurans from the Sea of Japan (1). S. A. CHERNOV: New data on the distribution of the Indian snake *Lycodon striatus*, Shaw, in Soviet Middle Asia.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, December 28

ROYAL INSTITUTION, at 3.—Dr. C. E. K. Mees: "Photography" (Christmas Juvenile Lectures. Succeeding lectures on December 31 and January 2, 4, 7 and 9).

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1935; with Report of the Director of Water Pollution Research. Pp. iii+51. (London: H.M. Stationery Office.) 1*s.* net. [3011

Centenary of the Birth of Andrew Carnegie. The British Trusts and their Work, with a Chapter on the American Foundations. Pp. x+155+29 plates. (Dunfermline: The Carnegie United Kingdom Trust.) [212

University of London: University College. Calendar, Session 1935–1936. Pp. xcii+578+26. (London: Taylor and Francis.) [212

Anniversary Address delivered before the Royal Society of London by the President, Sir Frederick Gowland Hopkins, November 30th, 1935. Pp. 26. (London: Royal Society.) [212

Other Countries

Union of South Africa: Fisheries and Marine Biological Survey. Report No. 12: For the Year ending December 1934. By Dr. Cecil von Bonde. Pp. 120+3 plates. (Pretoria: Government Printer.) [412

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 7: July, August, September, 1935 (Items 2728–2841.) By Ernest A. Hodgson. Pp. 141–156. (Ottawa: King's Printer.) 25 cents. [412

Tectonic Lines of the Philippine Islands. By the Rev. W. C. Repetti. Pp. 57–71+1 plate. (Manila: Bureau of Printing.) [912

U.S. Department of Agriculture. Leaflet No. 109: Eliminating Bats from Buildings. By James Silver. Pp. 5. (Washington, D.C.: Government Printing Office.) 5 cents. [912

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No 66: The Influence of Growth Stage and Frequency of Cutting on the Yield and Composition of a Perennial Grass—*Phalaris tuberosa*. (Report on Co-operative Investigations at the Waite Research Institute.) By Dr. A. E. V. Richardson, H. C. Trumble and R. E. Sharper. Pp. 35. (Melbourne: Government Printer.) [912

Ingeniørvidenskabelige Skrifter. A, Nr. 41: The Plate-Jet. By Jul. Hartmann. Pp. 108+19 plates. (København: G. E. C. Gad.) 15 00 kr. [912

The Indian Central Cotton Committee: Its Objects, Activities and Achievements. Second edition. Pp. 27. (Bombay: Indian Central Cotton Committee.) [912

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

No. 3452 SATURDAY, DECEMBER 28, 1935 Vol. 136

'Justice' in Africa

As the year draws to its close, the passing of time reminds us of the useful convention whereby we are encouraged to enter upon some sort of a stocktaking preparatory to the closing of the annual account. In such a survey of the past year, the chain of events which has threatened, and still endangers, the peace of the world must be a salient item. Here, however, the very magnitude of the issues involved hampers critical judgment, and while the event is weighed in the scale according as it has made for or against the working of the machine which we call the League of Nations, it may not readily be discerned that 'profit and loss' are not to be assessed in terms of the number of nations declaring their formal adherence to Article xvi, but rather in any real progress towards the universal application of the fundamental principle of justice as between man and man, towards which the League was a gesture of aspiration, as well as an admittedly imperfect piece of machinery for its attainment.

However posterity may apportion blame as between Italy and Abyssinia for breach of the peace—no attempt will be made here to estimate the merits of the dispute—there can be no question that the principle of the League, as well as the letter of its Covenant, has been violated. Should the League fail to vindicate that principle, through it the prestige of white civilisation will be affected throughout Africa.

The admission of Abyssinia to the League is a matter of past history. It is profitless now to discuss whether that admission was justifiable or not. But it would be idle to pretend that she stood upon an equal footing with other members of the League. Admission was an earnest of security in the upward struggle from barbarism to which her rulers were then committed; and this attack on her by a nation of advanced civilisation with all the resources of a modern armament at its command is a breach of an implied pledge of her right to integrity, which no political, diplomatic or economic argument can justify. It is a cynical reversion to the acquisitive methods of the nineteenth century, which led to the partition of Africa among the interested Powers of Europe.

The attack of Italy on Abyssinia, however strong the argument from economic necessity or pressure of population now that other outlets are restricted, is out of harmony with the spirit of the twentieth century. Native races—using the term in a loose conventional sense—can no longer be regarded as 'inferior' and mere raw material for exploitation, whose lands may be developed, regardless of their rights and interests, solely for the benefit of a superior white race. An attitude of mind more nearly in accord with the present trend of scientific study of racial problems demands that the relations between white and black, which are a consequence of the inevitable expansion of European civilisation, should be regulated by an adjustment of the conflicting claims which arise from the clash of two cultures in some respects incompatible but, it is hoped and indeed as experience is showing, not ultimately and entirely irreconcilable. Where white civilisation successfully vindicates its claim to the superior position, it is not as an overriding, but as a tutelary force. The final ruling, for all but areas of overwhelmingly white settlement, was given in the dictum of Lord Passfield's famous White Paper, in which it was declared that "the interests of the native must be paramount". This to the native is his Magna Charta, the warrant on which the

white administration must justify its control and occasional modification of native custom and belief. This was the spirit which framed the African mandates of the League of Nations; it is not the spirit or the practice of Italian colonisation, either in Cyrenaica or in north-east Africa. Settlement here is frankly and avowedly Italy overseas, with all that that implies in regard to native interests.

The moral obligation to guard and guide the native in changing conditions is naturally not confined to mandated territory, but rests on all administrations alike. To some critics this obligation seemed in danger recently, when the development of the Kakamega gold mines was under consideration; but in fairness to the Administration of Kenya it has to be admitted that the point at issue did not really arise out of a disregard of the interests of the native, but from a difference of opinion over the question of immediate benefits, especially financial and economic, as opposed to ultimate well-being, which anthropologists and others felt would be jeopardised by the displacement of native holdings, and the cultural disintegration which is inseparable from the opening up of any area in Africa to mining enterprise.

On difficult questions such as those raised by the Kakamega gold mines—questions of frequent occurrence, though not often arousing such widespread interest—much light is thrown by two recent publications dealing with the relation of governors and governed in East Africa. Of these Dr. Thurnwald's "Black and White in East Africa"* is especially valuable for his survey of the whole course of contact between an African tribe and European civilisation from its very beginning. He also examines in great detail the various measures by which the administration deals with every aspect of its native contacts, including its organisation for the improvement of native conditions in both a material and a spiritual sense, while at the same time he gives due heed to all interests, both black and white, involved in the problem.

It is to be noted that Dr. Thurnwald, in concluding, quotes in reference to 'the outlook' the evidence of certain prominent chiefs before a commission in 1932, in which they elaborated an argument that present conditions of education and labour tend to destroy among members of the younger generation the feeling that they have a stake in the country. This is attributed to the breaking up of the old closely-knit and strongly localised family and tribal ties through these agencies. This view is of importance as a native criticism of such current tendencies as aim at 'civilising' the native. Against it, on the other hand, must be set the view, which appears to be gaining ground in West Africa—naturally among the more advanced members of the native community—that 'indirect rule' and the anthropological approach to administrative problems have been formulated as a principle with the express purpose of retarding the development of the people. Extreme as this view may be, it is unnecessary to stress the importance of its recognition as an element in the problem of which account must be taken, lest the most progressive and intelligent among the natives should be alienated. Those who hold such opinions are not necessarily all discontented or disgruntled agitators.

Even more interesting than Dr. Thurnwald's book in certain respects is an account of an experiment in anthropological and administrative research combined, which was carried out in Tanganyika*. Dr. Gordon Brown, anthropologist, and Mr. Bruce Hutt, District Officer of Iringa, joined forces, and for a year worked in close and continuous co-operation, the administrator posing questions to the anthropologist as they arose in the course of his work, and the anthropologist supplying the answer from material obtained by an investigation made *ad hoc* among the people on the special point.

The result was illuminating in more directions than one. Most important perhaps for the future of 'indirect rule'—the Hehe, the tribe under investigation, came under indirect rule in 1926—is the clear demarcation of the limits within which the application of anthropological research to administrative problems is practicable; but no less useful was the experience of the manner in which the posing of a question by the administration may open up new lines of thought and research for the anthropologist.

In so far as it is possible to summarise the result of a co-operative effort, of which every detail is worthy of careful consideration by those interested in scientific research and native administration, the work of these authors would go to show that

* Black and White in East Africa: the Fabric of a New Civilisation; a Study in Social Contact and Adaptation of Life in East Africa. By Richard C. Thurnwald. With a Chapter on Women, by Hilde Thurnwald. Pp. xxii+419+16 plates. (London. George Routledge and Sons, Ltd., 1935.) 21*s*. net.

* Anthropology in Action: an Experiment in the Iringa District of the Iringa Province, Tanganyika Territory. By Dr G. Gordon Brown and A. McD. Bruce Hutt. (Published for the International Institute of African Languages and Cultures.) Pp. xviii+272. (London: Oxford University Press, 1935.) 7*s*. 6*d*. net.

in imposing indirect rule upon the tribes of Tanganyika, the administration builded better than it knew. For investigation of the *status quo*, which was accepted by the system of indirect rule as guiding principle, as for example in continuing in office the 'headman' of the old regime, has revealed that underlying the outward form were unsuspected ramifications going deeply into social and religious belief and practice, which would have been destroyed and their benefits lost by any change that, to superficial observation, might have seemed to be little more than one in form alone.

The extension of the form, or at least the spirit, of indirect rule in the British areas of administration—the position of the Union of South Africa and the French Colonial system demand separate consideration—is in itself an adequate rejoinder to inquiry as to how stand the backward peoples of Africa there in relation to the principles of which the League of Nations is at present the nearest approach to living expression.

The aim of indirect rule clearly is by means of care for the existing order to make haste slowly. Hitherto, the efforts of those who have the interests of Africa at heart have been directed to protection of the native through the preservation of his institutions; but this at the best is no more than a means to an end, an attempt to control the pace of development, and to avoid too rapid and disastrous breaking up of custom. But lest the native critic be justified, has the time not now come to ask ourselves: What comes next? What is the policy of development that lies behind and gives meaning to 'indirect rule', if it is not to be regarded as entirely static?

If any trust is to be placed in signs of the times, the day is rapidly approaching when some such question will have to be faced; and by the practical wisdom and foresight shown in the event will the answer given by white rule in Africa be judged. We now stand at a point far removed from Kipling's concept of "the 'eathen in 'is blindness", and, to revert to the issue from which we started, the proposals for a compromise in the Abyssinian conflict cannot be allowed to evade responsibility by treating whole territories and peoples, whose future is at stake, as pawns in a game. *Fiat justitia, rual cœlum*, it may be, is no motto for statesmen, who are 'realists'; but, unless the whole stream of history is destined to change its course, it is the acid test which will be applied by posterity. In the interests of world peace, it may be necessary to cede disputed territory, but under conditions which place the interests and well-being of the inhabitants before colonial ambition.

A Himalayan Expedition

Nanga Parbat Adventure:
a Himalayan Expedition. Translated from the German of Fritz Bechtold by H. E. G. Tyndale. Pp. xx + 93 + 80 plates. (London: John Murray, 1935.) 10*s*. 6*d*. net.

THIS is an account of the German-Austrian expedition of 1934, under the leadership of Willy Merkl, which attempted to climb the Western Himalayan mountain Nanga Parbat. This mountain culminates in a peak 26,620 ft. above sea-level—it is the tenth highest in the Himalaya. It rises directly from the Indus valley. Here it is possible to see in a single view from the river bed to the mountain top no less than 23,000 ft. of tremendous precipices. We believe this is the greatest amount of slope exposed in the world.

Nanga Parbat has unfortunately acquired an evil reputation. On its slopes in 1895, A. F. Mummery and his two Gurkha companions were lost. In 1932 a German-American expedition, also under the leadership of Willy Merkl, including two members of the expedition under review, failed to reach a greater height than 23,000 ft. owing to porter troubles and bad weather. On that occasion, porters were recruited from Nanga Parbat district "and there lay one of the main causes of its failure. Consequently it was decided at home to spare neither trouble nor expense in order to fetch Himalayan 'tigers' from Darjeeling to Kashmir", that is, men who had taken part in the Everest and Kamet expeditions. The original party comprised eight climbers, a group of three scientific workers, a doctor and a camp commandant, with a full complement of porters.

The expedition appears to have been well equipped when it reached the base camp, and both climbers and porters were experienced. Notwithstanding this, it met with the worst disaster that has befallen any Himalayan adventure. Of the advance party of sixteen, no less than nine lost their lives on the mountain—three Europeans,

including the leader, and six porters. In all, eight camps were formed above the base camp (13,012 ft.), the highest being 24,446 ft. From this point, so far as could be judged, there was no great mountaineering obstacle to be surmounted between it and the summit, which was about two miles (measured on the map) distant, while the actual nearest point reached, at a height of 25,300 ft., was only about one mile from the top, and some 1,300 ft. below it.

Here the whole advance party of five Europeans and eleven porters was caught in one of those sudden and violent storms which are a feature of the Himalayas. They had to retreat, when their goal seemed to be within easy reach, with the consequences already mentioned. Many gallant attempts were made at rescue, but all were driven back by the deep snow and blizzard.

When a disaster of this magnitude occurs, it is only natural and right to inquire so far as possible into the causes which may have led to it. It must be remembered every precaution may be nullified by the occurrence of a sudden and violent storm, accompanied by heavy snowfall. Having said this does not mean that the arrangements were free from criticism. One is forced, after reading this story, to ask the questions: Were the advance party sufficiently acclimatised? Were the high camps sufficiently equipped, before the final attempt was made, to provide for the contingency which actually occurred? Was the supporting party sufficient for the occasion?

Had camps VI and VII been provisioned and equipped with sleeping-bags, the storm might have been provided for, and the disaster at least mitigated, if not avoided. The narrative does not discuss these points. The advance party, which made the attempt on the summit, was so large as to leave very little support. It consisted of five European climbers out of the original total of eight. Drexel had died of pneumonia and Herr Bechtold, who was for a time a member of the advance party, was absent at the end, having escorted two exhausted porters to a lower camp, while another climber had returned sick to camp IV (20,300 ft.). It will be seen then how weak the supporting party was, and how very much lower down it was than the advance climbers, and with very difficult ground in between. With this distribution it would, in fact, have been difficult to keep up communication with those above even in fine weather, and in the actual circumstances quite impossible. When the danger in which the advance party found itself was recognised, every endeavour was made to help, but all failed in the face of the storm.

There were with the expedition a surveyor, a geographer and a geologist. While the rest were climbing they made a tour of the mountain. Their report, which is not included, should be interesting. The oxygen equipment which was with the expedition does not appear to have been used by the climbers. It was requisitioned from the base camp, but arrived too late for the gas to be administered to Drexel.

The book is illustrated by 110 magnificent photographs. There are three maps showing the routes taken and position of the camps. H. L. C.

The Molecules of Life

Die Röntgenspektrographie als Untersuchungsmethode bei hochmolekularen Substanzen, bei Kolloiden und bei tierischen und pflanzenlichen Geweben

Von J. R. Katz. (Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lief. 436. Abt. 2: Physikalische Methoden, Teil 3, Heft 6.) Pp. 3401–3716. (Berlin und Wien: Urban und Schwarzenberg, 1934.) 20 gold marks.

THIS book, which may be said to embody the long experience and considered views of one of the leading exponents of the X-ray method of structure analysis, is not concerned exclusively with the giant molecules of biological tissues, since it deals also with 'laboratory' colloids; but it is a direct and valuable contribution to a theme which must, deep down, be the theme of all scientific research. It seems to be clear now that we are living in an epoch marking, among other things, the decisive entry of physics and chemistry into biology, and the passage of time can only emphasise the great part played by X-ray analysis. The sooner, therefore, that its aims and principles become more familiar, the better.

Dr. Katz has tried here most conscientiously to minimise the difficulties and lay bare the pitfalls, and has strongly indicated what he considers the best method of approach; but as in all branches of science nowadays, there is always the trouble of limited time, and one has to live and work among crystallographers to appreciate to the full their point of view. Nevertheless, structure analysis is

essentially a habit of thought, the habit of thinking three-dimensionally: and this much at least can and should be acquired by all who are interested in the properties of molecules, especially those molecules, such as the proteins, polysaccharides and other high polymers and condensation products, in which is enshrined our very existence. It is the *shape* of molecules that counts in the end.

To one who is used to the research outlook of the English-speaking peoples, there is perhaps something lacking from this book: one misses rather the thrill and romance of advancing with the new physical weapons ever deeper and deeper into the biological unknown. Let us be cautious, by all means, but let us also be brave.

W. T. A.

The Cinematograph and the School

(1) The Cinema in Education:
a Handbook for Teachers. By D. Charles Ottley. Pp. xi + 130 + 4 plates. (London: George Routledge and Sons, Ltd., 1935.) 3*s*. 6*d*. net.

(2) The Film in the School
Edited by J. A Lauwerys. Pp. 140 + 4 plates. (London: Christophers, 1935.) 3*s*. 6*d*.

(3) A National Encyclopaedia of Educational Films and 16mm. Apparatus
Pp. 288. (London: Central Information Bureau for Educational Films, Ltd., 1935.) 21*s*.

(1) THE reviewer is biased against this volume by the statement on the jacket that "here for the first time the film's place in education is defined, its function analysed, and its possibilities as a teacher described in words that all may understand". This claims too much; but perhaps the book is better than it might appear. There is first an apologia for films in school, then the larger part of the book is taken up with accounts of films and projectors available, and finally there is a summary of a few lessons aided by films and a series of short statements about the use of films culled from various sources.

Too much has been attempted, and while it is true that many different subjects are mentioned, it is doubtful whether in fact enough is said on any one matter except 9·5 mm. films; indeed, if the cinema in education is the subject of the book, a quite disproportionate amount of space is devoted to these films, with which the author is evidently most familiar and on which he speaks with most authority. For the teacher who has a 9·5 mm. projector the book may be useful. The author points out, for example, that one advantage of these small films is that they can be bought outright and not hired, as are the 16 mm. films, and that consequently they can be edited and cut to suit the user; he gives examples of what he has done in the way of re-editing and combining films which he has bought, and shows how much can be done with them.

(2) "The Film in the School" is a contrast to "The Cinema in Education". Its purpose is clearly stated; it is "to give advice, as practical and detailed as possible, to those who would like to use films in their work", and it is fulfilled not unsatisfactorily. The book comprises seven chapters written by authorities on their subjects. The editor in the first chapter deals with "The Place of the Film in Education", with an emphasis on "place", and makes many interesting and valuable suggestions. Chapter ii, "Choosing a Projector", gives a clear and balanced account of the advantages and disadvantages of different kinds—not makes—of projectors. It may be noted in passing that a loose leaf supplies information on the picture-size and cost of most 16 mm. projectors, sound and silent. The third chapter deals with "The Film in the Classroom", and describes a few lessons which have been given with films. "The Mass Demonstration" is mostly devoted to giving the details of organisation of, and conclusions to be drawn from, the St. Pancras experiment by Capt. Griffiths, who took a prominent part in that experiment.

In the fifth chapter, on "Film Making in School", Mr. Ronald Gow points out that "as school textbooks are, naturally, written by teachers it is not unnatural to suppose that the educational film of the future will also be written by teachers" and gives accounts of films which he produced. Miss Mary Field describes the method and difficulties of the commercial producer of educational films, and in the last chapter the technique of "Using a Projector" is clearly described by Mr. Waley. There is an appendix which states the contents of the principal film libraries and a short bibliography.

It will be seen that the volume deals with facts, not theories, a welcome development in the literature of educational films.

(3) This "Encyclopaedia", though it has a different name, is in fact a new and much improved edition of the Catalogue of Educational Films published in 1933. Additions consist of articles, a

useful list of addresses of those from whom films may be obtained, lists of 16 mm. projectors, lists of film cameras and materials, and a library list.

The chief change is in the arrangement of the catalogue of films; these are now first listed under the headings 35 mm. and 16 mm.; each of these is divided into sound and silent films and these again into agriculture, art, biology and the rest. This is a very great improvement. Another change, which is not altogether an improvement, consists in giving the length of all films in reels, instead of using reels, feet and minutes; as the vast majority of films listed are of "1 reel" the information is not extremely useful.

The volume will save searching commercial catalogues, but it is not easy even yet to find what films are available on any particular topic on, say, 16 mm. silent stock—and that is the main use of a catalogue. Indeed, it still takes time to trace all the films in a particular subject such as geography; some of the best hide themselves under agriculture, science (anthropology) or engineering and industry.

Civilisation and its 'Crises'

The Source of Civilization

By Gerald Heard. Pp. 431. (London and Toronto: Jonathan Cape, Ltd., 1935.) 12*s*. 6*d*. net.

MR. GERALD HEARD, in his new book, has given us plenty to think about. The substantial merits of his work are, that it is a bold attempt at a comprehensive survey of human evolution, and that it is inspired throughout by a passionate belief that only by peace with his fellows, and a sense of harmony in the universe, can his full powers be developed, or rather, as Mr. Heard would say, can he escape his imminent destruction. In the first aspect—that of comprehensiveness—it is a brilliant expression of the current spirit which refuses more and more to limit the historical vision to politics and is eager more and more to trace backward by prehistoric discoveries the origin of the fundamental directions of human thought and action. It demands an evolutionary solidarity with all life.

In the second aspect, as a passionate pacifist manifesto, it is one of the most notable post-War publications. No one else has attempted—at least in English to our knowledge—so wide and detailed a denunciation of 'violence' in all its forms. When we criticise, therefore, it will be understood that it is with the deepest sympathy with the two main objects which Mr. Heard has in view. That it provokes, in that spirit, both scientific and historical criticism, is clearly a testimony to its force. Such widespread syntheses are one of the greatest needs of the time, but to be useful they must be met by friendly and searching examination.

The book, however, covers such an amazing wealth of facts and suggestions drawn from psychology, prehistory, Eastern philosophy and religious lore, that it is only possible here to make a few general remarks.

Mr. Gerald Heard's thesis, broadly speaking, is that man is naturally not a fighting but a pacific and friendly creature. He springs from a stage in the animal genealogy much further back than the brutal gorilla or any of the so-called 'primates', nearest in fact to the harmless tree-shrew. At an early stage he enjoyed a consciousness of his community with other animals, and the outside world generally, which he has since lost; and it is by the recovery of this at a higher stage of development that his salvation, if it is at all possible, will be secured. This early stage has now retreated into the depths of the subconscious, and the main purpose of psychology is to bring it again into the light. This was once apparently secured in the civilisation of what is frequently referred to as the "Eastern arc of the proto-civilisation" (represented by the recent discoveries in the Sind region). It was continued in the early culture of India, and on this account the practice of Yoga is so important. Except in this region, the early pacific civilisation was everywhere destroyed by 'violence' and individualism. This individualistic violence is promoted by the exercise of the mind in the one-sided exploration of external Nature, which tends to make man aggressive and acquisitive and is at the root of all the imperialisms from Assyria to the Great War. We must return and strive to regain a united consciousness, if civilisation in the true sense is to be saved.

Our criticism must be that such a scheme of human evolution, in spite of its many valuable sidelights and suggestions for further inquiry, is a simplification invalidated by its obvious *parti pris* and by the elevation of small and isolated facts into decisive arguments. The human stock, with its, say, half a million of years for distinctive growth, cannot be thus confined into one type of conscious life which we select as it suits our theory. That man's greater awareness was, as Mr. Heard says, his best qualification for a later rise, is abundantly clear, and that he rose and developed his powers because he was more adaptable. The

stress on these points contain some of the most valuable thoughts in the book.

But it is impossible to maintain that the earlier man had not also combative elements in his nature. His constant normal character is sufficient evidence of this, and the weapons and remains of slaughtered foes which are a part of so many prehistoric cites and excavations. We know little enough yet about our early ancestors in those vast æons of life, but we certainly know that fighting for their lives and their food was at least one element in their age-long task. When we come down to later times, in which historical records are available, it is no less clear that sword or 'violence' cannot be dismissed as an entirely decadent and harmful thing. Alexander's empire was not the mere "Macedonian raid" which is here described, nor was the Roman Empire the last word in stupid violence.

The whole story is much more complex than that; but one or two capital facts emerge which are not allowed for in such a condemnatory survey. One, that Rome gave us, in spite of her crimes, the framework of modern civilisation in which we live, and which, it may be added, shows more hope of surviving than Mr. Heard would allow. In fact, if we survive at all, which one may postulate without over-confidence, it will be owing, among other things, to the work of Rome, including her sword. Perhaps still more important is the fact that the Greeks, to whom we owe the first definite formulations of knowledge—both objective and subjective—did this work in a constant atmosphere of war. With them at least the fighting did not inhibit keen and disinterested thought.

A last word of criticism must be that the unifying work of science is scarcely allowed for at all. This is perhaps the most serious omission. It is omitted, because to admit it would be to admit that our present scientifically organised society is actually the most stable, whereas the argument requires us to believe that civilisation is in its most acute 'crisis' and can only survive if we retrace our steps. Retrace we cannot; advance, enlarge and correct we may. The correction will include much of what Mr. Heard desires, and, above all, the further suppression of the instinct to war, which is a diminishing and not an increasing factor in our make-up. But towards that most desirable of consummations we must include, as a prime and growing factor, the disinterested pursuit of truth both as to the world around us and our own nature; and it will consist rather in developing and making more articulate the conscious than in attempting to read and make a guide of the deep-down and often misleading promptings of the subconscious.

F. S. MARVIN.

Les fossiles: éléments de paléontologie
Par Prof. Marcellin Boule et Dr. Jean Piveteau. Pp. vii + 899. (Paris: Masson et Cie, 1935.) 170 francs.

HERE is a textbook of palæontology prepared for France, where the subject is considered apart both from biology and from geology. The introduction dealing with these subjects is of the shortest character, and is followed by a history of the science, in which the credit for its foundation is given to Leonardo da Vinci and Bernard Palissy, artists in paint and in clay.

The main part of the work is a systematic account of the organisms of the primary, secondary and tertiary periods, followed by that of quaternary man. Groups of organisms are treated in respect to their popularity rather than their scientific interest. Thus more than 500 pages are devoted to vertebrates, while such important phyla as Protista, Porifera and Cœlenterata together are only assigned 41 pages, while insects have 9 pages in spite of the great evolutionary interest of their fossil forms. From a biological aspect the classification often does not satisfy; thus the Stromatoporids were probably Foraminifera, while the Artiodactyles and Cetacea are usually regarded as derived from the Creodonts.

The author's technique is that of a fine museum guide rather than that of the more discursive and critical teacher. At the same time the latter will appreciate "Les fossiles", since most fossil genera are mentioned, while there are 1,330 figures, of which a very large percentage are original. Unfortunately, there is no bibliography to help the reader to dip deeper into the science.

Old and New: Thoughts on the Modern Study of History
By F. S. Marvin. (University Extension Library.) Pp. 224. (London: Ivor Nicholson and Watson, Ltd., 1935.) 4*s*. 6*d*. net.

THE title of Mr. Marvin's earlier book, "The Living Past", published in 1913, and frequently and deservedly reprinted, was almost a stroke of genius. In a phrase, it seemed to reveal, or at least to suggest, the true nature of the historian's task. The question whether history is a science has often been discussed, and is one which might naturally appeal to many readers of NATURE. Mr. Marvin is too wise to spend his efforts upon the somewhat academic question whether the methods and the materials of history fairly bring it into the category of what is usually called science. He prefers to go straight to the problem what we are really doing, or ought to be doing, in that study of the past which is called history, and how the process has been changed by the general movement of thought, scientific and philosophical, in modern times. He then proceeds to deal with certain selected aspects of history, by no means repeating his earlier work, but again leaving the reader with a high sense of human achievement, notwithstanding the terrible setbacks that have to be recorded. The chapters on the scientific work of the ancient Greeks, and on the marvellous technical advance in modern times, will prove specially interesting to scientific readers.

An Introduction to Comparative Zoology:
a Text-Book for Medical and Science Students. By F. G. Sarel Whitfield and A. H. Wood. Pp. x+354. (London: J. and A. Churchill, Ltd., 1935.) 15*s*.

HERE is a textbook for the Kitchener School of Medicine at Khartoum, and presumably the animals with which it deals form the syllabus of that School, together with some consideration of embryology, heredity, evolution, ecology and metabolism. The morphology of the types is done admirably. The size, print and especially the illustrations are exceptionally good. There may be a sufficient reason in the psychology of students for making the work so morphological in Khartoum, but the tendency in Great Britain is for the teacher to lighten morphology with a consideration, most elementary of course, of function in relation to the environment in which the animal dwells. Here much emphasis is laid on parasites, blood flukes, tapeworms, *Ascaris*, ticks and 'medical' insects being included besides all the types usual in Great Britain. This may be wise, for the applied side anyhow will have to be considered later by the student in a tropical country, where he will be seeing the effects of animal parasitism. In any event, parasites are not good forms on which to teach observation, which surely is of the first importance to the commencing student. If all these additional types are to be considered, why not omit the dogfish altogether? It has little to do with the Sudan and the course would be sensibly lightened without much loss.

(1) A Manual of the Common Invertebrate Animals, exclusive of Insects
By Prof. H. S. Pratt. Thoroughly revised edition. Pp. xviii+854. 7.50 dollars.

(2) A Manual of Land and Fresh Water Vertebrate Animals of the United States (exclusive of Birds)
By Prof. H. S. Pratt. Second edition. Pp. xvii+416. 6 dollars.
(Philadelphia: P. Blakiston's Son and Co., Inc.; London: J. and A. Churchill, 1935.)

THESE two books are thoroughly revised and greatly improved second editions, and are really two volumes of the same work. They aim at giving descriptions of the common invertebrates and vertebrates of the United States, by means of which their relationships and names may be determined. The insects are excluded, their half million or so of species obviously requiring separate treatment. The classificatory keys, the analytical tables and descriptions have been tested by us in several groups, and appear to be admirable, while the numerous illustrations (184 and 974 respectively) are well selected. They enable the visitor to the coast, mountain, plain or lake to name quickly any beasts that he may be watching in the open, or perhaps at home under magnification, with reasonable certainty, and this encourages him to observe. They are clearly books valuable in every classroom and library in North America, as similar synopses of the local fauna would be in any country.

West Coast Shells:
a Description in Familiar Terms of the Principal Marine, Fresh-water and Land Mollusks of the United States, British Columbia and Alaska, found west of the Sierra. By Josiah Keep. Revised by Joshua L. Baily, Jr. Pp. xi+350. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1935.) 17*s*. net.

FIFTY years ago, conchology was a hobby both in Europe and America, and most large seaside towns had societies for its study. The infinite variety and the beauty of the shells were their attractions, and it was not unusual to pay several pounds for a prime specimen. Now shells are recognised as a part of the complex of every coast, often governing factors in its formation. This rewritten book of Josiah Keep, originally published in 1881, is 'tuned up' to a new conchology that may well some day be as popular as the old. Oysters, razors, limpets, borers, burrowers, clams, etc., as titles of chapters indicate its key, and the technique of their consideration is both simple and scientific. British natural historians may well read it, for on the coasts of Britain dwell each of the above groups, but such would be well advised to take old Keep's advice: "While you admire their lovely shells, think even more of the quiet and pleasant lives they spend in their ocean home".

Wild Life Studies
By Frances Pitt. (Argosy Books, No. 3.) Pp. iv+189+9 plates. (London: Thomas Nelson and Sons, Ltd., 1935.) 3*s*. 6*d*. net.

THIS is a series of studies of the private lives of certain birds and beasts, most of them common dwellers in the English fields and hedgerows—voles, weasels, hedgehogs, peewits, owls, hawks and such. There are also two chapters on puffins and seals. Miss Frances Pitt writes on all these animals with an intimacy and humour which ensure ease and enjoyment for the reader, and the perusal of the book should certainly add interest and pleasure to a Nature lover's rambles. The author directs attention to the useful work done by animals commonly known as pests in a manner refreshingly free from sentimental special pleading. The pen drawings by G. E. Collins are delightful.

The Life and Writings of Giambattista Vico
By H. P. Adams. Pp. 236. (London: George Allen and Unwin, Ltd., 1935.) 8*s*. 6*d*. net.

A BOOK on Vico in the English language has long been overdue. Mr. Adams, in giving us the benefit of detailed studies of living Italian scholars, has revealed to a wider circle of readers the greatness of mind of one recognised by Goethe as a patriarch of modern thought. Indeed, after a detailed analysis of Vico's writings, Mr. Adams shows how he has influenced the trend of modern philosophy, from the eighteenth century down to the contemporary Italian thinkers. Thus the book under review will be found of interest to the historians of philosophy as well as to those of literature and political theory. T. G.

Charles Darwin as a Student in Edinburgh, 1825-27*

By Prof. J. H. Ashworth, F.R.S.

CHARLES DARWIN in his autobiography, written in 1876, gives in half a dozen pages ("Life and Letters", I, pp. 36–42) an account of his two academic sessions as a medical student in Edinburgh. This account includes brief references to his naturalist friends and acquaintances, a statement that he collected specimens in the tidal pools on the shore of the Firth of Forth and by going out with the "trawlers", and that he made new observations on the "so-called ova of Flustra", which "were in fact larvæ", and on the egg-cases of *Pontobdella muricata*.

It is now possible to form a more adequate conception of his early progress as a naturalist with the help of the minute book of the Plinian Society of the University of Edinburgh and of a notebook begun by Darwin in Edinburgh in March 1827, the latter of which I have been permitted to see by the kindness of Prof. C. G. Darwin and Mr. Bernard Darwin.

Charles Robert Darwin came to Edinburgh at the age of sixteen years and eight months, and with his elder brother Erasmus, who had been a medical student at the University in the previous year, signed the matriculation book, "Charles Darwin—Shropshire", on October 22, 1825. His class cards for the academic year 1825–26 were presented to the University of Edinburgh by the late Sir Francis Darwin in 1909, together with the wrapper inscribed by Darwin, in which they were found among his papers. The cards are: For the University Library, materia medica, chemistry, anatomy, clinical lectures, principles and practice of surgery and a 'perpetual ticket' for the Royal Infirmary.

In his autobiography, Darwin writes that the lectures "were intolerably dull, with the exception of those on chemistry by Hope. . . . Dr Duncan's lectures on Materia Medica at 8 o'clock on a winter's morning are something fearful to remember. Dr. —— made his lectures on human anatomy as dull as he was himself". The "Dr." referred to was Alexander Monro *tertius*, who did not sustain the great reputation made by his grandfather and his father, who had preceded him in the chair of anatomy. Darwin attended the clinical lectures and he records that he also "attended regularly the clinical wards in the hospital". He enrolled in the class of 'Principles and Practice of Surgery', but all that is known about his attendance in this subject is his own note that on two occasions he was present at "very bad operations"—these were before the days of chloroform—and that he "rushed away before they were completed".

In his second year at the University, Darwin enrolled in the classes of midwifery, practice of physic and natural history.

Robert Jameson, then fifty-two years of age, was, and had been for twenty-two years, professor of natural history, which then included zoology and geology. He devoted himself chiefly to mineralogy, but his published work shows his interest also in marine zoology and in birds, and as editor of the *Edinburgh Philosophical Journal* and of the *New Philosophical Journal*, he maintained a wide outlook on science in general. He formed an extensive and important natural history museum in the University of Edinburgh, which was notable for the excellent state of preservation of its specimens and their scientific arrangement and for its large collection of birds. The entire museum collection, said to have been, in Great Britain, "second only to that of the British Museum", was handed over a year after Prof. Jameson's death to the new Government Museum of Science and Art, now the Royal Scottish Museum.

Darwin found Prof. Jameson's lectures "incredibly dull"; "the sole effect they produced on me was the determination never as long as I lived to read a book on Geology, or in any way to study the science". Fortunately, he did not adhere to this decision; within ten years he had made the observations for his three geological memoirs, one of which, on coral reefs, has become a classic.

The detailed syllabus of Prof. Jameson's lectures, as drawn up by him in 1826, shows the range of his teaching, which included not only zoology and geology but also instruction in meteorology and hydrography and some reference to botany in its relation to "the animal and mineral kingdoms". The course of zoology began with a consideration of the natural history of man, was followed by an account of the chief classes of vertebrates and invertebrates, and concluded with lectures on the philosophy of zoology in which the first subject was "Origin of the Species of Animals".

This would be the course as given in Darwin's second academic year, and the lectures, which

* From an address to the Royal Society of Edinburgh on October 28, part of which formed the subject of a paper to Section D (Zoology) of the British Association at Norwich.

began on November 8, 1826, were on five days a week and were stated to extend over five months; hence there would be about one hundred lectures, in addition to which there were 'conversations' with the professor in the Museum, and excursions. While Prof. Jameson's teaching of some parts of geology was unacceptable owing to his adherence to extreme and discredited Wernerian views, the recorded judgments of Robert (later Sir Robert) Christison and of Edward Forbes on his teaching in general and on his enthusiasm for his subject and for the Museum under his charge show that they did not share Darwin's opinion of Prof. Jameson's course.

Although Darwin apparently did not receive from Prof. Jameson's lectures much instruction in zoology, he was able to acquire in other ways while in Edinburgh a considerable acquaintance with this subject.

Soon after coming to Edinburgh, Darwin became aware that his father would leave him "property enough to subsist on with some comfort" and this was, as he states, "sufficient to check any strenuous effort to learn medicine". Much of the time available after his attendance at classes would probably be devoted to his pursuit of natural history, especially during his second year when his brother was no longer with him in Edinburgh. His classes were in the same building as the Natural History Museum, and therefore any spare time could be immediately put to good use in the Museum, where he was likely to find at work two experienced naturalists, Dr. Robert Grant and William Macgillivray, whom he came to know well. Further, his membership of the Plinian Natural History Society brought him into association with other enthusiastic naturalists in Edinburgh at that time.

The Plinian Society was founded in 1823, and the two minute books from February 1826 to the end of the Society's existence in 1841 are preserved in the University Library. The Society, which met every Tuesday evening in the College or University of Edinburgh, had about one hundred and fifty members, but the number recorded as being present at the meetings does not usually exceed twenty-five. The secretary in February 1826 was Dr. Robert Grant, and the record includes the names of those present and of those who took part in the discussions.

Darwin was elected a member of the Society on November 28, 1826, and at the meeting a week later, at which the election of officers and council took place, he was chosen as one of the five members of the council, from which it may be concluded that he was very favourably known for his interest in natural history. There were five presidents—Messrs. Ainsworth, Coldstream, Kay, Browne and Fife—three of whom, Browne, Coldstream and Fife, had proposed Darwin for membership of the Society. He states in his autobiography that he found the meetings of the Society stimulating and that he "used regularly to attend"; the record shows that he was present at all but one of the nineteen meetings held from the date of his election to April 3, 1827.

The minute book is of interest as showing the subjects discussed in the students' natural history society in Edinburgh one hundred years ago, and it indicates the wide range of the communications presented during the period of Darwin's membership. Darwin is noted as having participated in the discussions on four of the evenings; it would have been particularly interesting to know what he said on the principles of natural classification and especially on specific characters when he spoke in the discussion on that subject.

On March 27, 1827, not "at the beginning of the year 1826" as stated in the autobiography, "Mr. Darwin communicated to the Society two discoveries which he had made:

(1) "That the ova of the Flustra* possesses organs of motion".

(2) "That the small black globular body hitherto mistaken for the young of Fucus lorius [loreus] is in reality the ovum [or, as he wrote in the autobiography, the egg-case] of the Pontobdella† muricata".

At the request of the Society, Darwin promised to draw up "an account of the facts and to lay it, together with specimens, before the Society next evening". The minute of the next meeting records that he presented to the Society "a specimen of the Pontobdella muricata with its ova and young ones", but does not mention any account, and if the manuscript was placed before the Society it has not been kept.

In his note-book, Darwin gives under the date April 20 a short account of the yellow embryos and ciliated larvæ of *Flustra carbasea*, records that two other species produced motile "ova" and adds a description of the egg-cases of *Pontobdella* and of the young leech when ready to escape. These observations, which occupy four and a half pages of the note-book, were not published by Darwin.

Three days previous to Darwin's paper at the Plinian Society, that is, on March 24, 1827, Dr. Grant read to the Wernerian Natural History Society of Edinburgh, as the minute under that date records, "A Memoir regarding the Anatomy and Mode of Generation of Flustræ, illustrated by preparations and drawings", and "a notice on the Mode of Generation of the Pontobdella muricata of Lamarck".

* *Flustra*, the 'sea-mat', a genus of Polyzoa, obtained by dredging or found thrown up on the shore—the brown sea-weed now known as *Himanthalia lorea*.

† *Pontobdella*, a leech frequently found on the skate and hence often called by the fishermen the skate-leech.

Grant's paper contains a more detailed account than Darwin's of the ova of *Flustra* and of the ciliated embryos and larvæ which Grant reared in watch-glasses into young colonies.

Grant prepared a description of the cocoons of *Pontobdella*, published in the *Edinburgh Journal of Science* of July 1827, in which he stated that "the merit of having first ascertained them to belong to that animal is due to my zealous young friend Mr. Charles Darwin of Shrewsbury, who kindly presented me with specimens of the ova exhibiting the animal in different stages of maturity".

Another significant factor in Darwin's studies in natural history in Edinburgh was his friendship with some of the Newhaven fishermen, whom he sometimes accompanied when they dredged for oysters "and thus got many specimens". His note-book records *Pennatula mirabilis* (now *Virgularia mirabilis*) and *Pennatula phosphorea* from the Firth of Forth, which were no doubt obtained in that way; the cocoons of *Pontobdella* which he found on oyster and other shells were probably collected on some of these expeditions, and he procured his specimens of *Flustra carbasea* "from the dredge boats at Newhaven".

Darwin's note-book, which is inscribed on the fly-leaf "Charles Robert Darwin, March 1827", provides interesting evidence of his observations on animals collected in the Firth of Forth. He found a lumpsucker stranded on the rocks at Leith and "dissected it with Dr. Grant"; a fairly complete examination was made of its internal organs including the heart and its valves. He records and sketches the "ova" (egg-masses) of several molluscs, adds sketches of the ciliated larvæ of three of them, and gives brief descriptions of the two sea-pens, *Virgularia mirabilis* and *Pennatula phosphorea*, which he had procured no doubt with the help of the Newhaven fishermen. The last zoological entry in the note-book is that he "observed with Mr. Coldstream" a starfish, which he identified as *Asterias rubens*, but which was almost certainly a specimen of the closely similar starfish first differentiated from *rubens* as a new genus and species by Michael Sars in 1846 and now known as *Leptasterias mülleri*. Darwin saw his starfish in the act of discharging its eggs. In this species the eggs are incubated in the space enclosed by the arched disc and the inwardly bent bases of the arms.

With Darwin's Edinburgh notes were two lists of animals, one of "the Vermes found in the Frith of Forth and other parts of Scotland" abstracted from a paper by Prof. Jameson (1811), and the other of "Fishes found in the Frith of Forth" from a paper by Patrick Neill (1811). Each list was written on two double sheets, about 6 in. × 3½ in., and the two sheets were fastened together by a strip of gummed paper. These lists could be carried in a pocket-book, and would be convenient for reference in his collecting expeditions.

Darwin left Edinburgh late in April 1827, when little more than eighteen years of age, and early in the following year went to Cambridge.

Reference was made to Darwin's friends in Edinburgh, of whom the most important was undoubtedly Dr. Robert Edmund Grant, then about thirty-three years old. He had graduated M.D. Edinburgh in 1814 and had studied natural history and medicine in 1815–20 in Paris and other Continental universities. He returned to Edinburgh in 1820 and explored the coasts of Scotland and Ireland and made studies, including dissections, of many animals which he collected. Grant was the author of a series of papers on sponges in 1825 and 1826, and many of the observations therein recorded were made on the shores of the Firth of Forth. In addition, he published or wrote, in the years 1825–27, more than a dozen other papers on Cœlenterata, Mollusca, Polyzoa, Crustacea, on the structure of the eye of the sword-fish, and on the anatomy of the *paca* of Brazil; he was at that time a most energetic collector and investigator, especially of marine invertebrates. Darwin states that he often accompanied Grant to collect animals in the tidal pools, and he records in his note-book that he dissected with Grant the lumpsucker he had found at Leith. It was a great advantage to Darwin to have this experienced zoologist as his friend.

In his autobiography Darwin relates that one day when he was walking with Grant the latter "burst forth in high admiration of Lamarck and his views on evolution"; Darwin adds that he listened in silent astonishment, and so far as he could judge without any effect on his mind. That exposition on Lamarck acquires fuller significance when it is remembered that Grant studied in Paris during the period 1815–20, and that he would devote much of his time to work in the Museum of Natural History, where he would very probably come into association with Lamarck only a few years after the latter had published his "Philosophie Zoologique" (1809) and while he was preparing his great work on the natural history of invertebrates (1815–22).

In the summer of 1827 Grant left Edinburgh to become the first professor of zoology in University College, London.

William Macgillivray, thirteen years Darwin's senior, was, during the time Darwin was a student in Edinburgh, assistant and secretary to Prof. Jameson and acted as assistant-keeper of the University Museum of Natural History. He was known for his papers on molluscs and on birds, and

was afterwards (1841) appointed professor of natural history in Aberdeen. With him Darwin "had much interesting natural-history talk", and while birds are not specifically mentioned, it is scarcely possible that Darwin could be in frequent association with Macgillivray—whom the late Prof. Alfred Newton regarded, after Willughby, as "the greatest and most original ornithological genius save one (who did not live long enough to make his powers widely known) that this island has produced"—without utilising such an opportunity of acquiring some of his special knowledge of the classification and structure of birds. Darwin records that in Edinburgh he had lessons on preparing birds from a Negro who had travelled with Waterton, and there is extant evidence of his interest in birds at this time in two 'keys' in manuscript found among his Edinburgh notes. One is a key to the genera of British birds and the other, to about one hundred genera of birds, was "copied from Brisson's *Ornithologie*, 4th Edit. . . . 1826", hence it was written during his second academic session.

Darwin "became well acquainted with several young men fond of natural science". He mentions Ainsworth, Coldstream and Hardie (this should be Arding, a member of the council of the Plinian Society), but he might have added the other presidents of the Plinian Society—Kay, Browne (father of Sir James Crichton-Browne) and Fife, with whom also he would be frequently associated during his last five months in Edinburgh. These men were all senior to Darwin by two to four years; Browne was already L.R.C.S. and the others qualified in medicine in 1827.

Darwin attended, with Grant, meetings of the Wernerian Natural History Society and heard, among others, Audubon, who spoke at the meetings in December 1826 and January and February 1827, and he was present at one meeting of the Royal Society of Edinburgh, where he saw Walter Scott in the chair as president.

I suggest that if, with the information now available, Darwin's experiences in Edinburgh are reviewed, there are good grounds for the conclusion that, while he gained comparatively little from the formal lectures, he had excellent opportunities, of which he appears to have availed himself fully, of developing his early taste for natural history and collecting, and that in Edinburgh he laid the foundation of his knowledge of the science of natural history.

Utilisation of Pine Forests

CELLULOSE PULP

A STUDY of the methods of utilising the vast areas of pine forests which occur in various parts of the world is a matter of considerable importance from the scientific and economic points of view, and both aspects have recently received considerable attention in Australia and in the United States. In each case the manufacture of cellulose pulp for the paper and allied industries has been the main objective; but the problem has been approached from somewhat different aspects in the two countries. Thus, the American workers have erected a large-scale experimental plant, and have carried out numerous pulping trials, whilst in Australia a more fundamental study of the chemistry and structure of the woods has first been made, with small-scale pulping trials to provide additional information. The two studies are therefore, in a sense, complementary; and it is interesting to consider them together.

It is well known that the objection to the use of the southern type of pine for pulping has always been the high resin content, which is a source of considerable trouble to the paper-maker. It is true that the soda and sulphate (kraft) processes of digestion remove most of this, but such methods are not always desirable for economic reasons. The mechanical and acid (sulphite) processes, which are generally preferred, provide no solution of the resin problem; it seems, in fact, that the latter induces polymerisation of the resins, which are thereby converted into an objectionable substance resembling pitch.

The key to the problem appears to be the differentiation of the sapwood and the heartwood, and it has been found from investigations on thinnings, which contain very little resinous matter, that the elimination of heartwood also eliminates the resin trouble. As an example, in the case of the longleaf pine, the average figures given for the resin in the sapwood and heartwood are 2 and 7–10 per cent, respectively. With this is also involved the question of the diameter of the tree, because in the past there probably has not been a full appreciation of the great diameter to which a tree can grow before the sapwood begins its transformation into heartwood; this is in spite

of the fact that, so long ago as 1897, F. Roth[1] stated that this transition really begins before the tree is twenty years old, and that twenty to twenty-five years is the usual age. Roth also found that the average diameter of the fibres of the spring-wood is about twice that of the summer-wood, so that, unless this difference is taken into account, measurements of the relative widths of such woods may give a false idea of the total amounts present.

The analytical data compiled by W. G. MacNaughton and F. Allen from various published sources[2] and from their own work confirm the fact that, as indicated by Roth, the difference in apparent density of the spring- and summer-woods depends on the wood structure. They also demonstrated the low resin content of southern pines free from heartwood. Laboratory pulping tests were carried out on these young pines both by the sulphite process and by mechanical methods, and average yields of 45 and 93 per cent being obtained, respectively; these are similar to the average figures obtained with other species of the wood.

The engineering and the economic aspects of the problem have been more fully discussed in several publications by C. H. Herty[3]. A small-scale plant has been erected in Savannah, Georgia, under the auspices of the Department of Forestry and Geological Development, and reels of paper 26 inches wide can be made on a small Fourdrinier machine. In order to overcome the difficulty of 'blue stain', due to sap in the summer season, experiments were made with green wood, and contrary to expectations this was found to give a pulp almost free from resin trouble. On the other hand, after seasoning for three months, the pitch trouble was more pronounced, and as this is contrary to experience with northern spruce, it suggests the desirability of an investigation into the natures of the resin from these two sources and the changes they undergo on seasoning.

Herty's account of this work is marked by an enthusiasm which, in view of the commercial possibilities involved, is probably justified. It is reassuring nevertheless to turn to a paper by L. C. Anderson[4] which is an independent account of the behaviour of the new pulps on a modern Canadian newsprint machine. Incidentally, the paper so made was used by the Georgia newspapers for a special edition to commemorate the event. A mixture of 25 per cent of sulphite and 75 per cent of ground wood (both from Loblolly pine) was used, and the complete absence of pitch trouble was confirmed. The data show quite definitely that from the point of view of the operator the utilisation of these pulps presents no unusual difficulties. On the other hand, the paper produced is considered to be poorer in quality than that made from spruce or balsam. It was limp to the hand, and the tensile and bursting strengths and smoothness and porosity values were all poorer than the corresponding average data for the northern woods. It must be remembered, however, that the pulps were prepared in a plant of experimental scale, and it is a well-known fact that the quality of pulps may usually be corrected as a result of tests on the paper made from it. There is little doubt therefore that a process operated in the normal way would give better results.

A more recent development of the work in the Georgia laboratories is the production of cellulose for viscose rayon, and Herty and Rasch[5] have described the properties of the material obtained by a short high-temperature digestion process; the yields of cellulose were 88–90 per cent.

It is now of interest to turn to the contribution of the workers in Australia, where the numerous afforestation schemes of recent years have resulted in the planting of large areas of pines, mainly *Pinus radiata* (*insignis*). The utilisation of this material is obviously of the same economic importance here as in Georgia, and the problems are very similar.

In the first of a series of chemical investigations on *Pinus radiata*, W. E. Cohen[6] deals with the nature and distribution of the non-volatile ether-extractives and the occurrence of heartwood. Eighty-five samples (6–22 years old) from South Australia, Victoria and New Zealand were extracted with ether, and the acid and ester values of the extract were determined. Experimental sulphite pulping tests were also made on a sample from a 22-year-old tree.

The results suggest that seasonal variations and changes in the nature and amount of the ether-extractive during storage are more important factors than have hitherto been realised, and that the age of the tree and the amount of heartwood present bear no definite relationship to the yield of extractives from a whole log section. The amount of ether-extractive in the inner rings was always more than in the outer rings, especially when the former contained heartwood. The ratio of the acid value to the ester value was taken as an indication of the nature of the resinous matter; the acid content is raised when heartwood is present, and high yields of resins having a high ester value are obtained in the presence of resin ducts such as occur usually in trees 16–18 years old. There is also evidence that the time of collection affects the results, because young samples (6–12 years old) collected in March had a much lower acid/ester ratio than those collected in September.

The pulping tests established definitely the difficulty of dealing with wood containing appreciable amounts of heartwood, and an increased temperature-gradient and penetration-period were required in such cases. The resin-contents actually obtained were the very low figure of 0·35 per cent for pulps from sapwood, and 3·84 per cent from heartwood pulps. No pitch trouble was experienced with the former, but the indications are that the latter would give trouble from this source.

J. G.

[1] U.S. Dept. Agric., Division of Forestry, Bull. 13; 1897.
[2] *Paper Trade J., Tech. Sec.*, **97**, 14; 1933.
[3] *ibid.*, **96**, 161, 1933. **101**, 48; 1935.
[4] *ibid.*, **98**, 109, 1934.
[5] *Rayon and Melliand Text. Monthly*, **16**, 107. *Amer. Dyestuff Rept.*, **24**, 124; 1935
[6] *J. Coun Sci. and Indust. Res., Australia*, **8**, 27; 1935.

Recent Research on Cancer

THE twelfth annual report of the British Empire Cancer Campaign gives summaries of the past year's progress in most of the cancer research centres of the British Empire. During the year, more than £32,000 has been distributed by the Campaign in encouraging and supporting research along a very broad front, extending from pure physics, such as methods of inducing radioactivity in normally inactive elements, to the study of the origin and development of tumours in the human body. With the hope of improving and extending clinical research, a new clinical research committee has been formed with the co-operation of all the London teaching hospitals. Such an organisation can help considerably in comparing results and preventing overlapping and duplication of research.

The problem of the cause of cancer has been attacked mainly by means of experimental carcinogenesis, in many different institutes. Many years ago, Fibiger found that gastric cancer occurred in rats fed on cockroaches infected with *Gongylonema neoplasticum*, when the rats become hosts for the parasites. Prof. R. D. Passey has now found that infected rats do not develop cancer if they are fed on a full and healthy diet in place of the white bread diet used in Fibiger's experiments. This indicates that diet may influence the occurrence of malignant disease. In the Cancer Hospital Research Institute a new, very active carcinogenic compound, methyl cholanthrene, has been produced from deoxycholic acid (a normal constituent of bile), and has been synthesised. In structure, methyl cholanthrene is allied to sterols and sex hormones and to other carcinogenic agents, and it is conceivable that a similar active carcinogenic compound might arise adventitiously in the body by some 'error' of metabolism. This suggests a possible link between industrial cancer, such as that of gas workers and mule spinners, and natural or spontaneous cancer.

Sarcomata have been induced in fowls by synthetic carcinogenic agents and by tar in many different laboratories, and attempts have been made to obtain a filterable virus from the neoplasms so obtained. Prof. J. McIntosh has described three tar-induced sarcomata capable of propagation by cell-free filtrates. On the other hand, careful work carried out in Sheffield, Glasgow and Edinburgh, with fowl tumours induced by 1 : 2 : 5 : 6-dibenzanthracene, has not given any evidence of a filterable virus in these tumours. Prof. E. Mellanby has found that the virus of the Rous chicken sarcoma, which can be propagated by cell-free filtrates, is present, not only in the normal organs of infected birds, but also in dibenzanthracene tumours of birds bearing the filterable tumour. If a fowl bearing a tumour induced by 1 : 2 : 5 : 6-dibenzanthracene is infected with Rous chicken sarcoma, the virus of the latter passes into the dibenzanthracene induced tumour, so that an extract of the dibenzanthracene tumour injected into other fowls produces tumours resembling the Rous tumour and not the dibenzanthracene tumour.

In the study of tumour viruses, the high-speed centrifuge is being developed into a useful tool. The air-driven and air-floating centrifuge is relatively simple and inexpensive, and as it rotates at 40,000–60,000 r.p.m. it makes it possible to subject liquids to forces up to 70,000 times that of gravity. By means of this centrifuge it is possible to concentrate the active agent of fowl sarcomata. The concentrates contain elementary bodies, possibly virus particles, which can be examined under the microscope

Work on the nature of the changes occurring in isolated cancer tissue continues to give interesting results, but the problem of the anomalous high rate of lactic acid formation in the presence of oxygen remains unsolved. Dinitro-phenols which cause increases in temperature and metabolism in man and animals also increase the respiration and lactic acid production of isolated tumour tissue—the mechanism of the biological effect of nitrophenols is still obscure. On the other hand,

naturally occurring coloured oxygen carriers such as pyocyanine and lactoflavine increase the oxygen consumption and decrease the lactic acid formation of tissues. Dr. F. Dickens has found that other dyes which are photo-sensitisers, such as phenosafranine, cause increased aerobic lactic acid production. It is remarkable that some irritants such as mustard gas (dichloro diethyl sulphide) and cantharidine prevent or delay the carcinogenic action of tar or similar agents. Dr. I. Berenblum and Dr. L. P. Kendal found that these anti-carcinogenic agents are able to inhibit glycolysis to a greater extent than respiration. It seems to the present writer that this effect may be allied to the effect of iodoacetic acid inhibiting the lactic acid production of muscle.

In the recently formed Cancer Department of St. Bartholomew's Hospital, a million volt X-ray plant is being installed. This should give a more powerful source of short-wave radiation than any radium bomb or X-ray plant at present in use. The results from this plant will be of extreme interest. The present report gives data referring to the radiological treatment of patients in many hospitals, and the pooling of results in this way must be of value in assessing the value of radiological methods in clinical work.

Radiations from radium and X-ray tubes have been used in many experiments on chick embryo and on tadpole tissues. Gamma-rays are found to have most effect on cells that are about to divide; once cell division has commenced, the process completes itself in a normal manner even in the presence of gamma-rays. The first effect of gamma-radiation is therefore apparently to reduce mitotic activity; but this is followed in turn by periods of apparent recovery, degeneration, abnormal mitosis and final recovery. Further examination of the effect of radium on tissue cultures of chick embryo tissue seems to indicate that the lethal effect depends on the actual amount of radiation rather than the time over which the radiation is spread.

Several specimens of human carcinoma removed in operation have been grown *in vitro*. An interesting phenomenon demonstrated by Dr. T. Lumsden with tissue culture methods is the action of antibodies capable of killing cancer cells *in vitro*. The effect of the anti-cancer sera has now been photographed with a cinema camera, and the death of tissue culture cells in the presence of the serum is strikingly shown in the film. It would be of interest to see the effect of the rat anti-cancer serum on tissue cultures of human carcinomata.

It was shown some time ago that snake venom had a toxic effect on malignant growths. The toxic effect of cobra venom on tumours is not prevented by anti-venom serum, and it may be possible to check the toxic effect of the venom on the host without inhibiting the effect on the cancerous growth. This is possibly a hopeful method of attacking the problem of curing cancer. With the active research that is being prosecuted along so many divergent lines in many laboratories, it is possible to say that advances are being continually made, but by which way the goal will be attained it is quite impossible to forecast.

Obituary

Prof. Charles Richet

A STONE'S throw from the tip of the headland of Giens, in the south of France, there is a cluster of rocky islets. One of the most picturesque of them is pointed at with awe by the local country folk, as the home of a famous old man who carried out mysterious experiments and tried to communicate with the world beyond. It was, indeed, the country home of Prof. Charles Richet, well known in physiology and abnormal psychology, who died on December 3 in Paris.

Physiology and medicine owe to Richet the discovery of anaphylaxis, in 1902, which marked a decisive advance in modern medicine, and for which he was awarded the Nobel Prize for Medicine in 1913. This discovery was the result of a series of experiments and researches dating so far back as 1887, a year before the foundation of the Pasteur Institute, when Richet was the first to carry out an injection of serum into a human being. He was thus one of the founders of serotherapy.

In 1902, Richet was studying with Portier the action of the poison of sea-anemones, when they remarked that dogs which had withstood without any inconvenience an intravenous injection of a minimal dose of an aqueous extract of the tentacles of *Actinia*, always died after a second but weaker injection administered to them in the same way a few days later. But as this second injection was not strong enough to kill a fresh animal, they came to the conclusion that the first dose of a serum does not always immunise, but on the contrary, renders the organism more sensitive for a certain period and though the effect of the first dose seems to have disappeared. Thus were cleared up many mysterious cases of intoxication and an explanation was forth-

coming, in particular, of the occurrence of sudden death after repeated and successful administration of serum. The name of 'anaphylaxis' was given by Richet to this type of sensitiveness; and since that time a number of experiments have considerably improved the practice and effectiveness of serotherapy. Richet's "Dictionnaire de physiologie", begun in 1895, is a comprehensive study of the whole subject. He also wrote "Recherches sur la sensibilité" and "La Physiologie des muscles et des nerfs".

In later years, Richet was interested more and more in psychology and especially in the investigation of borderland phenomena. He objected to the use of the words "abnormal" or "occult" in connexion with such phenomena, as he held them to be just as natural as any others, and therefore just as much entitled to investigation by the ordinary methods of science. In 1905, the year in which he was elected president of the Society for Psychical Research, he proposed to give the name *Métapsychique* to the new science of these phenomena, which he classified under three principal types: cryptesthesy (clairvoyance), telekinesy (action at a distance without contact) and ectoplasmy (materialisation). He contended that as these phenomena occur, they must be real and subject to laws which ought to be discovered by unbiased scientific investigation. These views, which follow closely the work of Sir William Crookes (1872), are illustrated in his "Thirty years of Psychical Research", of which an English translation appeared in 1923, and which is an immense collection of cases of varying evidential value. A smaller volume, partly based on the first, appeared in English in 1929 under the title "Our Sixth Sense". Though Richet considered metapsychics to be still in its infancy, he hoped, with many other distinguished philosophers and psychologists, to see it gradually develop into a full science.

In the realm of psychology proper, Richet adopted the mechanistic theories of Descartes, which he endeavoured to extend to man himself, as had already been suggested by Lamettrie's "L'Homme Machine". Mind cannot be independent of matter, but rather subject to its fundamental laws. There is no gap between the psychical and the physiological; and the 'higher' faculties of man can be easily explained by inferior phenomena with such laws as those of reflex movements, of irritation and of association ("Traité de psychologie générale", 1912). Consequently, if introspection is useful for the study of the decisions of the conscience, it cannot help in the investigation of psychological phenomena, which must be entirely experimental. This ruthless determinism, which was well in keeping with the prevalent ideas among French men of science at the beginning of this century, caused Richet to deny the necessity of any metaphysical conceptions and to predict the death of metaphysics.

Charles Richet was born in Paris on August 25, 1850. Following the footsteps of his father and his maternal grandfather, he studied science and medicine and obtained an M.D. at the Paris Faculty of Medicine in 1876. He then worked under Marey at the Collège de France, and in 1887 he was appointed professor of physiology and medicine in the University of Paris. His first discovery was that of the presence of hydrochloric acid in the gastric juice. He investigated the relation between respiration and the area of body surface; and he carried out a good deal of research on animal heat. He also studied the problem of epilepsy and the treatment of tuberculous patients by dieting them on raw meat.

The interests of Charles Richet were not limited to physiology and psychology. He followed from the beginning the development of aeronautics and he made a name for himself as a novelist and a playwright, two of his plays ("Socrate" and "Circé") having been performed at the Odéon, in Paris. He was also a convinced pacifist and président of the Société pour l'Arbitrage entre les Nations. A member of the Academy of Medicine since 1896, Charles Richet was elected in 1914 to the Academy of Sciences. His scientific jubilee was celebrated in 1926, at the Paris Academy of Medicine, with the official participation of savants from many countries. On that occasion, Marshal Foch invested him with the insignia of Grand Cross of the Legion of Honour. T. G.

WE regret to announce the death last September in his seventieth year of the eminent Italian physiologist, Prof. Luigi Mariano Patrizi, who was born at Recanati near Ancona on September 13, 1866. He studied under J. Moleschott in Rome, where he qualified in 1890. After serving as assistant to Angelo Mosso at Turin, he occupied in succession the chair of physiology at Ferrara (1894), Sassari (1896) and Bologna (1924). During the period 1911–24 he was professor of criminal anthropology at Turin. His work was chiefly concerned with the psychometry of attention, the physiology of the intellect and criminal physiology and psychiatry. His publications include a psycho-anthropological study of Leopardi and his family (1896), the physiology of the bandit Giuseppe Musolino (1904), "The Orator" (1912), "After Lombroso" (1916) and a work on the physiological measurement of the emotions and passion (1924).

WE regret to announce the death on November 19, at the age of sixty-six years, of Dr. Dan McKenzie, who besides being a consulting surgeon in diseases of the ear, nose and throat and a former editor of the *Journal of Laryngology and Otology*, was a keen student of medical history and folk-lore. In addition to a textbook on his speciality, of which the second edition appeared in 1927, he was the author of "The City of Din" (1916), "Aromatics and the Soul: a Study of Smells" (1923), and "The Infancy of Medicine: an Enquiry into the Influence of Folk-Lore upon the Evolution of Scientific Medicine" (1927), of which a notice appeared in NATURE of January 28, 1928, p. 133.

News and Views

Sir Archibald Geikie (1835-1924)

THE centenary of the birth of Sir Archibald Geikie falls on December 28 this year; it is a fitting occasion to remind older geologists of what many of them owed to him during their earlier years for his teaching and writings, and to direct the attention of younger geologists to the changes that have come over the science since Geikie began his labours. It was his good fortune to take up geology when major principles still required documentation and exposition; he devoted much attention to the significance of denudation in the shaping of existing forms of land surface and to the results of volcanic activity, and in pursuit of field evidence travelled extensively in Europe and North America. Possessed of a logical mind, great industry and a lucid and dignified prose style—which gave him pleasure to employ—he early assumed and continued during his life to occupy a leading position as an exponent of physical geology. During his tenure of office as director-general of the Geological Survey of the United Kingdom he secured opportunities for a considerable literary output, including the compilation of his great textbook, first published in 1882, which after several revisions is still in use, but how different from its successors with their lavish employment of photographic reproductions. Sir Archibald corresponded freely with his geological contemporaries abroad, worthily maintaining the status of British geology, and he received generous recognition from many foreign societies. He took an active part in the administration of scientific institutions, and held the presidency of the Royal Society in 1904 and of the British Association in 1892; but it was as a writer of readable geological literature that he earned the appreciation both of the serious student and the general reader, and made thereby an indelible mark on his epoch.

Education and Administration among Backward Peoples

IN another column of this issue of NATURE (see p. 1003) it is suggested in discussing 'indirect rule' of native peoples in Africa that the anthropological approach to problems of native administration is open to the danger of taking too conservative a view in the attempt to regulate the effects of cultural contacts. How this is to be avoided, without at the same time impairing the lessons of anthropological study, is the main thesis of an essay by Mr. F. C. Williams, Government anthropologist of the Territory of Papua, which was awarded the Wellcome Medal for Anthropological Research by the Royal Anthropological Institute in 1933 ("The Blending of Cultures: an Essay on the Aims of Native Education": Territory of Papua, Anthropology, Report No. 16. Government Printer, Port Moresby. Pp. 46. 1*s*.). Mr. Williams, whose conclusions, necessarily, are largely coloured by his experience in Papua, points out that, rightly regarded, the problems of native education and native administration are one. Education, thus understood, he maintains is a process of three operations, or "tasks":—maintenance, fostering necessary or desirable elements in native culture; expurgation, eliminating undesirable elements, such as sorcery, cannibalism and head-hunting; and expansions, which, while recognising that change is inevitable, seek to guide it by the incorporation of progressive elements which native culture is ready to assimilate, as, for example, improved methods in horticulture. It will be noted that this throws upon the administration the responsibility of formulating a 'blend' of cultures, which is both conservative and progressive, and will not prove detrimental to native character and morale. This demands an intensive study of native culture, but at the same time one which the successful administration of native affairs in Papua has shown to be not impossible.

The Outlook for Consumers

UNDER this title, P.E.P. (Political and Economic Planning) issues a broadsheet, No. 63, which should interest everyone, because all the world is a consumer and comparatively few are producers or distributors. We all think that we suffer, at times, from the greed or petty dishonesty of those who stand on the other side of the counter, yet for the most part we grin and bear it, taking little thought of the methods that might be used to give us value for our money. Fundamentally, the problem is the one that is penetrating ever more deeply into the social conscience, namely, how the proceeds of useful human labour should be apportioned equitably among producers, distributors and consumers. Some are convinced that the principle now ruling is that of the jungle—sweets to the sweet and the hindmost to the devil—and that pending the time when men are educated morally to the same degree as some are now educated intellectually, the only solution is the total elimination of 'profit' in the Marxian sense, or drastic regulation of profits, as now practised in certain Continental countries.

OTHERS, however—and P.E.P. is apparently among them—assume that, in the main, what was, will be, and that desirable changes can or should be effected only on the basis of the existing order: evolution rather than revolution. It is from the latter point of view that the authors of the broadsheet approach the subject of consumers' interests, and after laying down that, as a rule, the buyer gets what he deserves, and that to effect any useful change he must stir himself and co-operate with his fellows, they proceed to enumerate and discuss five possible ways in which the consumer can assist himself or be assisted. One way of helping the consumer is to improve the shops. For several reasons, the old personal relationship

between shopkeepers and customers has largely disappeared, and the former are no longer the trusted purchasing agents and advisers of the latter; goods are left to sell themselves; the salesman merely wraps them up, sees that they are paid for, and passes them over the counter. The recent foundation of the Retail Trading Standards Association is a move in the right direction, but will not prove effective unless more consumers take an active interest in standards and exert a firm but constructive pressure to secure a fair deal for the consumer.

A SECOND way is for consumers to elect or appoint representatives to protect their interests. Parliament cannot be expected to concern itself with detailed questions, but special consumer councils might succeed if they could arouse public interest. Thirdly, the consumer might be protected by direct Government action. Certain State departments, for example, the Ministry of Health and the Board of Trade, already help in this respect; but they do not go far enough and can only deal with cases that come within the ambit of the law: their services are certain to increase, but no great good can be done unless public opinion is aroused and made effective through a special consumers' organisation. Another method of helping the consumer is suggested by the success of Consumers' Research, Inc., in the United States, a voluntary organisation that investigates goods offered for sale and marketing practices, and makes known the results to its members. Closely allied to the concept of a consumers' research organisation is that of a 'trade union', which would comprise consumers of certain specified products, would stand up for their rights and bring pressure to bear when occasion demanded. An example of such a body is represented by the Automobile Association, which recommends hotels and garages, elaborates route plans and provides free legal defence.

Economics of the U.S.S.R.

IN a recent issue of the *Manchester School*, Vol. 6, No. 2, there is an interesting article on "U.S.S.R. Economics—Fundamental Data, System and Spirit" by Prof. M. Polanyi, who points out that the present moment appears to be a favourable one for taking stock of the achievements of the Russian Revolution. Socialism has been definitely instituted, and communism has been relegated to an uncertain future. Also the recent introduction of a marketing system makes it easier to review the economic situation, as we can now compute values in terms of money. Planned economy is a corollary of communism, but in fact, Prof. Polanyi states, a system of planned economy has never been attempted in the U.S.S.R. since the repeal of communism in 1921. For one thing, as Stalin bluntly admits, there has never been a proper distributive system at all. The First and Second Five Year Plans were not systems of planned economy, but merely systems of planned production, and even this is an overstatement for no great stress was laid on the systematic nature of the plan. The Soviets claim that they have carried out the First Five Year Plan, but in doing so they pass over in silence the biggest item of their plan, namely, the planned increase of agricultural production by fifty-five per cent; instead of this being achieved, a very serious fall took place during the first five year period. During the last four years, the outline of an economic system based on the principles of marketing has been developed. Prof. Polanyi concludes that while he is convinced that no return to private ownership is possible in the U.S.S.R., it seems that public and collective management is developing on lines almost identical with those in the marketing system of capitalism.

Watt Bicentenary Exhibition at the Science Museum

A SPECIAL exhibition was opened at the Science Museum, South Kensington, on December 20 to commemorate the bicentenary of the birth at Greenock on January 19, 1736, of James Watt, the famous engineer and inventor. The exhibition will remain open until April 19. Many objects of particular interest are being shown, including three original beam engines, two of which were erected in Soho Manufactory in 1777 and 1788 respectively and the third in London in 1797, and various original experimental models, including the separate condensers of 1765 which led to his most important contribution to the development of the steam engine. The Garret Workshop, where Watt frequently worked from 1790 until his death in 1819, and which was moved with its contents from Heathfield Hall near Birmingham to the Science Museum in 1924 for permanent preservation, is on view. A large number of drawings, some by Watt himself, have been lent by the Birmingham Public Libraries Committee and form a detailed survey of the progress in steam engine design from 1775 until 1800, the period of Watt's partnership with Boulton. Numerous portraits of Watt, Boulton and their scientific friends have been generously lent for the occasion by the National Portrait Gallery, the Victoria and Albert Museum, the Royal Society, the City of Birmingham Art Gallery and others. About one hundred letters between Watt and Boulton have been selected from the voluminous correspondence preserved at the Assay Office, Birmingham, which gives an intimate picture of Watt's difficulties and achievements. Some of the memorials and books written on the life and work of Watt are exhibited also. Catalogues of the Memorial Exhibition, the Garret Workshop and the Stationary Engines Collection are on sale in the Science Museum. Special Bicentenary Lectures are being given by the guide lecturer in the lecture theatre and the gallery on various days during the period of the exhibition. Particulars can be obtained on application.

Function of the American Chemical Society

IN his address at San Francisco on August 19 in receiving the Priestley Medal of the American Chemical Society, Prof. W. A. Noyes said that the two outstanding problems to be solved by our generation are the abolition of war, and a better

distribution of work and the products of our industries. Chemistry can no longer be thought of as an isolated branch of science, and independent of the rest of our lives. While providing for the development of personality and initiative, it is necessary to restrain those who will not contribute their share in co-operative service. Discussing the growth of the American Chemical Society, Prof. Noyes referred to the proposal to start a journal of organic chemistry as the outcome of a feeling that the Society does not sufficiently provide for the publication of non-industrial research. Emphasising the fact that chemistry is not an isolated science sharply divided from physics, biology, or even economics, sociology and political science, Prof. Noyes suggested instead the publication of the existing journal in two parts. The first part, published early each month, would contain the papers at present classified under the heading, "General, Physical and Inorganic". The second part, published late in each month, would appear under the sub-heading "Organic and Biological". Both parts would appear under the heading *Journal of the American Chemical Society*, and the pagination would be continuous. A single index would be issued, but each part would have its own editor. In concluding, Prof. Noyes discussed the question of training, the importance of giving all students a broad knowledge of our chemical heritage, and of encouraging the chemist to see his work as a unit in a co-operative democratic organisation which serves the community and gives a reasonable return to workers, directors and capital.

"Purging" Scientific Literature in Germany

THE *Chemiker Zeitung* of November 30, p. 978, prints a notice to German chemists requiring them in future to avoid the use of "foreign" words. It is explained that this can easily be accomplished, and among the illustrations given appear the following:

Forderanlage	instead of	Transportanlage
wirtschaftlich	,,	rationell
fur, or je	,,	pro
durchlassig	,,	porös
zusammenpressen	,,	komprimieren
Nachahmung	,,	Imitation
Stück	,,	Exemplar
Ausmasse	,,	Dimensionen
umgrenzen	,,	definieren
Hochstwert	,,	Maximum
Tiefstwert or Niedrigstwert	,,	Minimum.

Vorbild, *Form* or *Muster* are suggested as alternatives to *Schema*, but the Editor, having perhaps seen comments on this subject in the notice of Joos' "Lehrbuch der theoretischen Physik" and in subsequent correspondence in NATURE (September 28, p. 495, and October 26, p. 675), points out that such innovations as *Kleinschwerkzeug* for *Mikroskop* and *Scheidekunst* for *Chemie* should not be adopted, as they might be regarded as ridiculous by others.

New Telephone Developments

IN the *Review* (No. 3, 1935), published in English by the Ericsson Telephone Factory of Stockholm, there are described two interesting developments of telephony. One of them is called the 'laryngophone' which has been specially designed for use in aircraft. Owing to the noise in airships, ordinary carbon microphones with diaphragms cannot be used. The diaphragm of the new telephone is actuated by being lightly pressed against the throat in the neighbourhood of the larynx. For aircraft, it is necessary to have both hands free, and a headphone of normal design can be conveniently fitted in the pilot's helmet, the laryngophone being worn without discomfort inside his collar, extraneous noise not being transmitted by it. This type of instrument can be usefully applied for fire control on warships, in engine rooms, on motor vehicles, tanks, etc. The other instrument is useful in connexion with the buoy-telephones which have for many years been used in the submarines of the Swedish navy. In the latest development, two buoys, with buoy telephones, are used. Each buoy contains a telephone set, and an electric lamp is fitted on the top of it. Flash signals are sent from the submarine to attract attention to the buoy. An instruction plate on the buoy tells how to open the lid of the compartment containing the telephone set, and the submarine is rung up in accordance with the directions printed on a plate on the telephone cover. Buoy telephones are fitted at each end of the submarine. The lamps are supplied from the 110 volt accumulator of the submarine and light up when a watertight telegraph key is closed.

The British Film Institute

THE British Film Institute's second annual report, issued on October 1, records notable advances (long overdue) in its task of "furthering effective co-operation between those who make, distribute, and exhibit films on the one hand, and all who are interested in the artistic, educational, and cultural possibilities of films on the other". The scope of its activities is indicated by the chapter headings: The Cinema for the Schools, Free Trade in Educational Films, National Film Library, Vouchers of Approval, Entertainment Panel, Dominions, India and Colonies Panel, Medical Panel, Scientific Research Panel, Summer Schools, International. Its regular publications comprise *Sight and Sound*, on sale to the general public at 6*d.*, quarterly; a monthly film review on sale to associate members at 2*d.*; and news letters circulated to members. In addition, there are occasional leaflets of which the best known, No. 5, on projection apparatus and films for schools, achieved a circulation of nearly 10,000; another, No. 8, gives a full account of the National Film Library established by the Institute last July. A scheme has been worked out for the award by the Institute of vouchers of approval to films voluntarily submitted to it for examination and, as a corollary of this, expert and authoritative advice is given to producers before and during production. The Entertainment Panel has undertaken a systematic inquiry

into the supply of suitable films for children's performances. The Medical Panel has compiled a catalogue of British medical films and will issue supplements from time to time. The Scientific Research Panel is collecting material for a report on the extent to which the cinematograph is, and can be, used in the advance of scientific knowledge. The first Film Summer School for teachers was held at Scarborough last August. Ten local branches, known as Film Institute Societies, have been at work during the year, at Becontree, Bristol, Brighton, Chichester, Leeds, London, Manchester, Liverpool, Belfast and Salford.

Research and the British Academy

PROF. J. W. MACKAIL, in his presidential address to the British Academy delivered in July last (Oxford University Press, pp. 11. 1*s*. net), laid it down as a principle that "the products of the Academy as an organised body . . . are all, in their different ways, and from their different angles and lines of approach, means towards an end", which he went on to define further as including two interlinked motives: to maintain a standard of learning and to preserve the continuity of civilisation. This view of the functions of the Academy would lay a heavy burden of responsibility on any body, however august; but if the further dictum be accepted that it is by the first that the second may be most directly and most effectively attained, it adds an impressive weight to the opinion the president expressed at an earlier stage in his address, that the Academy's grant from the Treasury of £2,000, only recently restored to its full amount, is quite inadequate. In the field of pure scholarship, certain enterprises, it is true, have been able to make progress through the Academy's subsidy. Yet even here, in what might be regarded as the Academy's special province, in number they make a poor showing. In the vast and wider fields of humanistic studies the prospect is even less encouraging. In archæological research, now that the excavations at Samaria have been brought to an end, apart from the contribution to the British School of Archæology in Iraq, which stands in a special category, the only body to which the Academy contributes is the British School of Archæology in Jerusalem. Archæological research unfortunately falls between the two stools of science and letters, belonging to the one by its technique, to the other in the applications of its results. This contention apart, in comparison with Continental academies, the British Academy is second to none in the standing of its fellowship; but its material contribution, as a body, to the advancement of the subjects which have been brought within its purview is negligible.

Mining in Tanganyika Territory

WE have received an interesting pamphlet from Tanganyika Territory entitled "Mining Publicity Pamphlet", and issued by the Department of Land and Mines. It shows at the outset a useful map of the Territory, and after a short introduction there is full information for all prospective immigrants, including such points as the customs duties and the mining and prospecting laws which have been adopted. There is an account of the geology and physiography of the Territory, and economic minerals and mineral production are fully described. We find, for example, that the value of mineral production has increased largely and in many cases has doubled since 1932 when Great Britain went off the gold standard, with a correspondingly rapid rise in the price of the precious metal; in fact, the value of all minerals has increased since 1932 with the exception of mica, which is less than half in 1934 what it was in 1932; whilst the value of the minerals produced is put down as close on £200,000 in 1932, in 1934 they had risen to close upon £364,000. Gold mining is, of course, a great attraction at present, although the pamphlet states that "it is to be anticipated that the internal prosperity it [gold production] is creating will exert its beneficial influence on other forms of mining within the territory". This is one of the few regions where the old-time prospector still finds work, and existing gold fields, containing both reef gold and alluvial gold, are fully described in the pamphlet in question. The pamphlet is of distinct use to immigrants proposing to enter Tanganyika Territory, and its perusal is strongly recommended to any who are proposing to go out, and especially perhaps to those intending to follow gold mining.

The Spahlinger Tuberculosis Vaccine

A JOINT committee on tuberculosis of the Medical Research Council and the Agricultural Research Council has issued in the form of a green paper (London: H.M. Stationery Office, 2*d*. net) observations on the experiment with Spahlinger vaccine in Northern Ireland, the report on which was issued some weeks ago. In this experiment, 11 calves were vaccinated with the Spahlinger anti-tuberculosis vaccine, and 7 calves were kept unvaccinated as controls. Six months after the vaccination, all the calves were given the same dose of virulent tubercle bacilli intravenously. The difference in the effect on the two groups was striking. Of the 7 controls five died of acute tuberculosis within 25–73 days. On the other hand, none of the 11 vaccinated animals died from the acute disease, one died on the 607th day, and the remaining 10 lived until slaughtered on the 783rd–890th day. All, except one, of these were in good condition although found to be tuberculous to greater or less extent. The joint committee concludes that a case has been made out for further investigation, that the number of animals used in the Irish experiment were not enough to give statistically conclusive results, and that the general use of the vaccine should be deferred until a thorough investigation has been made.

The Physique of Man in Industry

IN 1927, the Industrial Fatigue (now Health) Research Board published a report of an inquiry on "The Physique of Women". The results of this inquiry appeared to be of such value that the Board decided to institute an investigation of the same kind

amongst men. Prof. Cathcart directed the work, assisted by Messrs. Hughes and Chalmers, and in the analysis of the data by Miss Blair and Miss Werner, and their report has now been issued ("The Physique of Man in Industry". Med. Res. Council. I.H.R.B. Report No. 71. H.M. Stationery Office, 1935. 1*s*. 3*d*. net). It records the physical examination of 13,656 male volunteers aged fourteen years and upwards in fifteen areas in England and Scotland. The total includes 10,593 employed men, 1,328 unemployed men and 1,735 students. The data recorded were height, weight, grip (both hands), pull when standing, and distance of middle finger tip from the ground. The student group had the highest average height and weight, but were inferior in strength to those in manual occupations. The unemployed group was slightly inferior in weight, and definitely inferior in strength, to the employed group. No certain index of physical fitness, industrial or other, was discovered. From the average elbow height (43 in.) of the employed, it is deduced that the comfortable height of a working bench for the average man standing should be about 38 in.

Biological Control of the Mediterranean Fruit Fly

THE Mediterranean fruit fly (*Ceratitis capitata*) has, for many years, caused ravages among many kinds of edible fruits in the Hawaiian Islands. The introduction of several species of parasites from Africa and Australia has resulted in a very appreciable reduction in the abundance of the pest in question, but a sufficiently efficient degree of control, from the commercial point of view, has not so far been achieved. We learn from Science Service, Washington, D.C., that a scheme has been put in hand which involves further application of biological control methods. In order to carry out the project, the Hawaiian Planters' Association is sending two of its entomologists, along with others from the Department of Agriculture, to Africa with the object of searching for suitable parasites. Other entomologists are proceeding to Brazil with the same aim in view. The whole project is being administered by the U.S. Bureau of Entomology in conjunction with the leading local organisations concerned in Hawaii. The Hawaiian Islands are famous as being the territory where some of the most successful examples of the biological method of pest control have been achieved. The plan of campaign against the fruit fly is expected, if successful, to lead to great benefits to the small farmers of the territory by increasing the supply of fruits that grow so luxuriously in those islands.

New System for Nature Recording

AFTER much discussion, extending over two quarterly meetings, the council of the British Empire Naturalists' Association has agreed to form a special section to deal with field natural history records. A properly spaced system of observers is to be built up all over Great Britain, and eventually a committee of experts will be formed to decide upon the problems to be tackled, and the methods to be adopted. Plans are at present being made for a conference of branch secretaries in London next April. For some ten years, the British Empire Naturalists' Association has worked a system of publishing in its quarterly journal, *Country-Side*, bird, plant and insect records of seasonal and statistical interest, grouped in the various counties. Not only was this incomplete, in that records were more quickly forthcoming from southern areas richest in resident naturalists, and other northern areas were neglected, but also in flora especially no complete review could be made owing to the necessity of finding room for other matters in the journal. The new scheme will be welcomed by historians of field natural history, who often have to go through masses of local and national publications for scattered field records of varying value.

A New Natural History Magazine

A NEW German periodical, edited by A. Benninghoff, K. Beurlen, K. Hildebrandt and K. L. Wolf, offering a variety and standard of contributions which ought to commend it to many readers, has recently appeared. The title, *Zeitschrift für die gesamte Naturwissenschaft*, suggests the breadth of its objective, the scope of which is extended by the inclusion of Nature philosophy and the history of Nature knowledge and medicine. The articles of the first issue (April) are not over-long—about fifteen pages—a short summary precedes each, and the matter, while avoiding too technical treatment, makes a serious contribution to the subjects discussed. K. Hildebrandt writes upon "Positivismus und Natur", and other major articles deal with "Morphologie und Erdgeschichte", "Bedeutung und Aufgabe geologischer Forschung", "Subjektbezogenen Nomenklatur in der Biologie", "Warum studieren wir Biologie ?", to which the final answer is "Wir studieren Biologie, weil wir mussen". A variety of subjects are discussed in short contributions, and there are seven signed reviews of books.

Use of the Astrolabe

ALTHOUGH the astrolabe has found some support among surveyors, it has not been widely used by British astronomers. An extensive account in English of the practical use of the modern astrolabe has recently been published by Mme. Chandon and M. Gougenheim in the *Hydrographic Review* (**12**, No. 1). This account contains full details of the working and practical operation of various modifications of the astrolabe, and should be studied by all who are interested in the accurate determination of position. It may be hoped that this paper will stimulate astronomers to devise a means of eliminating personal equation from the astrolabe, so that the instrument may eventually compete with the transit circle in the accurate determination of longitude.

Pathological Investigations at Edinburgh

IN the annual report for 1934 of the Laboratory of the Royal College of Physicians of Edinburgh, by the curator, Sir Robert Phillips, an account is given of the research and other activities. Much work has

been done, particularly on the pathology of the mamma, by Miss Dawson, and about 1,000 reports on tumour growths were issued; the sections made, together with the material from which they are derived, are preserved and indexed for future reference and research. The death rates of Great Britain and Sweden and the spread of infectious diseases have also been investigated statistically. More than 15,000 examinations of specimens for medical men were carried out.

Society for the Study of Alchemy and Early Chemistry

A SOCIETY for the Study of Alchemy and Early Chemistry has been founded in London. It is intended to place the study of alchemy and early chemistry on a broad basis, and for this reason the Council of the Society is desirous of securing the co-operation of scholars in various countries who will contribute to the interests of the Society. It is proposed to hold regular meetings, beginning early in 1936, at which papers will be read and discussed, and to publish a journal in which accounts of the papers will be given as well as special articles, written contributions by members of the Society and reviews of books. The following council has been elected: Prof. J. R. Partington (*chairman*), Dr. F. Sherwood Taylor (*Editor of the Journal*), Gerard Heym (*Hon. Secretary*), K. de B. Codrington, L. F. Gilbert, Prof. S. R. K. Glanville, Sir Richard Gregory, Dr. E. J. Holmyard, Dr. D. McKie, Dr. L. W. G. Malcolm, Dr. Stephen Miall. Further information can be obtained from the Hon. Secretary, Society for the Study of Alchemy and Early Chemistry, 8 Bream's Buildings, Fetter Lane, London, E.C.4.

International Geological Congress, 1937

THE organisation committee of the seventeenth session of the International Geological Congress, which will meet in Moscow in 1937, has issued a second circular outlining the scope of the various subjects proposed for discussion. In connexion with the problems associated with the geology of petroleum and coal, it is hoped to make an estimate of the oil reserves of the world and to review the coal resources of the U.S.S.R. and other countries. A discussion of the stratigraphy, igneous cycles, tectonics and mineral deposits of the Pre-Cambrian is proposed. The stratigraphical limits of the Permian System, at present a source of widespread controversy, again comes up for consideration. An attempt is to be made to correlate tectonics, magmatic evolution, ore deposits and geochemistry, and as a further theme a review of the data bearing on these problems with special reference to Asia is proposed. Another geochemical problem is that of the occurrences of rare elements. Geophysical subjects to be discussed include measurement of geological time; isostasy and anomalies of gravity; terrestrial magnetism; and seismology. Finally, it is hoped that reports will be presented on the history of the various branches of geology. Further particulars may be obtained from the General Secretary, Dr. A. E. Fersman, Sretenka 8, Moscow 10.

Announcements

DR. H. S. GASSEN, professor of physiology at Cornell University, New York, has been nominated director of the Rockefeller Institute in succession to Dr. Simon Flexner.

PROF. YAS KUNO, until recently of the Japanese Medical College, Mukden, South Manchuria, and now of the Institute of Physiology, Kyoto Imperial University, Japan, has been appointed a member of the Permanent International Committee of the Physiological Congresses. This is the first time that a representative of Far Eastern physiology has been appointed to the Committee. Prof. Kuno was a pupil of the late Prof. E. H. Starling at University College, London, and is a member of the Physiological Society, Great Britain. He has done very important work on perspiration and body temperature, and has written an excellent book on the subject.

MR. M. C. LAMB, principal of the Leathersellers' Technical College, will retire from his present position at the termination of the current session, having then attained the age of sixty years. Mr. Lamb has been associated with the College from the time of its opening in 1909, and has had forty years' experience in the teaching of leather technology, having been appointed a demonstrator in the Leather Department of the University of Leeds so far back as 1895. During the period of his occupation of the principalship, the College has been progressively successful, and is now regarded as the most efficient and best equipped of its kind in the world, attracting students from every centre where leather is produced.

AMONG the awards for 1935 made by the Royal Horticultural Society are the following: *Victoria Medal of Honour*, Sir Daniel Hall, for his scientific work in connexion with horticulture; *Veitch Memorial Medals*, Dr. A. D. Cotton, for his services to horticulture, and Prof. E. J. Salisbury, for his book "The Living Garden"; *Loder Rhododendron Cup*, Mr. A. Rehder, of the Arnold Arboretum, U.S.A., for his work on the genus *Rhododendron*.

A DISCUSSION on "Probability" will be held by the London Mathematical Society on January 16, at 5 p.m., in the rooms of the Royal Astronomical Society, Burlington House, W.1. The following have promised to take part: Prof. H. Levy, Sir Arthur Eddington, Dr. P. Dienes, Prof. R. A. Fisher, Dr. Harold Jeffreys, Prof. J. B. S. Haldane.

IN reference to the article on the annual Congress and Exhibition of the British Institute of Radiology in NATURE of December 14, p. 960, Dr. J. Read informs us that the first continuously evacuated tube constructed by Lauritzen worked intermittently at 750 k.v., not 600 k.v.; also that the Soiland Clinic tube worked at 550 k.v., not 100 k.v., and that the Clinic has now installed three 200 k.v. constant potential Latour circuits in cascade in place of the cascade transformers.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1030.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Mathematical Psychology of War

THIS is relevant to the Naval Conference. A letter in NATURE of May 18 was intended to show, by reference to historical facts, that a certain pair of equations did represent, at least crudely, the behaviour of nations prior and subsequent to the Great War. In order to proceed to deductions, it is convenient now to change the notation. The hypothesis aforesaid is that

$$\frac{dx}{dt} = ky - \alpha x + g \quad . \quad . \quad . \quad . \quad (1)$$

$$\frac{dy}{dt} = lx - \beta y + h \quad . \quad . \quad . \quad . \quad (2)$$

in which x denotes the variable preparedness for war of one group of nations, y that of the opposing group; t is the time; k and l are 'defence coefficients'; α and β are 'fatigue-and-expense coefficients' and g and h are measures of dissatisfaction with the results of treaties. Each of k, l, α, β, g, h is regarded as temporarily constant. Of these, k, l, α, β are each positive; but g and h may have either sign, and will be positive for the 'have-nots', negative for the 'haves'. The international situation is thus represented by a point (x, y) in a plane. Let us think of this point as a particle moving in accordance with the equations. If the particle be tending towards plus infinity of both x and y, then war looms ahead. But if the particle be going in an opposite direction the prospect is peaceful.

If dx/dt be zero, the equation (1) represents a straight line; similarly for dy/dt and equation (2). The intersection (x_0, y_0) of these two straight lines is the point of balance of power. It is given by

$$x_0 = (kh + \beta g)/(\alpha\beta - kl), \; y_0 = (lg + \alpha h)/(\alpha\beta - kl) \quad (3), (4)$$

But, unfortunately for those who live under a policy of balance of power, the point of balance has several awkward possibilities. First, by a rare chance, $\alpha\beta$ might equal kl so that the lines would be parallel and no point of balance would exist. Secondly, it is quite probable that the point of balance may be situated in one of the quadrants where x or y or both are negative; so that balance could be attained only by negative preparedness for war, that is, by positive preparedness for co-operation. Thirdly, although the particle is undoubtedly in equilibrium when it coincides with the point of balance of power, yet that equilibrium may be unstable.

To investigate stability the equations have been solved by a standard method via the auxiliary equation

$$m^2 + (\alpha + \beta)\, m + \alpha\beta - kl = 0\,; \quad . \quad . \quad . \quad (5)$$

and it is found that the particle, wherever it begins, will ultimately arrive at the point of balance (x_0, y_0) if

$$kl < \alpha\beta, \quad . \quad . \quad . \quad . \quad (6)$$

whereas the particle will ultimately go off towards infinity if

$$kl > \alpha\beta. \quad . \quad . \quad . \quad . \quad (7)$$

That is to say: the international régime is unstable if, and only if, the product of the two defence coefficients exceeds the product of the two fatigue-and-expense coefficients.

In the unstable régime, the particle will tend towards one or other of two opposite infinities according to where it begins. We may classify the starting points by making a transformation to polar co-ordinates (r, θ) centred at the point of balance, so that

$$x - x_0 = r\cos\theta, \quad y - y_0 = r\sin\theta \quad (8), (9)$$

For then

$$\frac{d\theta}{dt} = l\cos^2\theta + (\alpha - \beta)\cos\theta\sin\theta - k\sin^2\theta, \quad . \quad . \quad (10)$$

whence it follows that there are always two real lines given by

$$2k\tan\theta = \alpha - \beta \pm \sqrt{(\alpha - \beta)^2 + 4lk} \quad . \quad . \quad (11)$$

on which $d\theta/dt = 0$. The particle cannot cross these lines. They form barriers dividing the plane into four angular portions. In particular, if $\alpha = \beta$ and $l = k$ the barriers are at $\theta = \pm\pi/4 \pm \pi$. When the balance of power is unstable $(kl > \alpha\beta)$ the barrier at $\theta = -45°, +135°$, or in general at

$$2k\tan\theta = \alpha - \beta - \sqrt{(\alpha - \beta)^2 + 4lk}$$

is of profound significance, for it divides the international plane into two portions, one of a drift towards war, the other of a drift towards co-operation.

The 'constants' are liable to secular change. The progress of engineering and chemistry has notably decreased α and β, so that if l and k were unchanged, the international régime would now be much more unstable than it was a century ago. The defence coefficients k and l are influenced by the suspicion or goodwill distributed by print or broadcast.

Over all, it must be remembered that the equations describe the rivalries of two groups having populations of the same order of magnitude. In the new tentative practice of 'collective security', one population is many times greater than the other, and a quite different course of events may be expected.

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Chemical Action caused by Neutrons and Gamma Rays and the Effects of these Agents on Colloids

FOR more than a year we have been engaged in investigating the action of neutrons and γ-rays: (*a*) in affecting the stability of colloids, and (*b*) in promoting chemical reactions. As sources of γ-radiation we have used platinum containers filled with radium sulphate, or radium emanation sealed into glass tubes surrounded by a few millimetres of lead. Neutrons were obtained from sources similar to these to which metallic beryllium had been added. Since all the neutron sources used emitted γ-rays, every titration was carried out in triplicate on (1) a non-irradiated control; (2) a specimen irradiated by γ-rays alone; (3) a specimen irradiated by neutrons and γ-rays from the same or an equal source. The strengths of the sources ranged from 30 mC to 150 mC and the periods of irradiation from a few hours to two weeks.

Irradiations were usually carried out in the following manner. The sources were enclosed in a test tube which contained either water and a metallic lead filter, or a solution of borax and a cadmium filter. This tube was surrounded by a glass vessel containing the liquid under examination. The test tube and vessel were again surrounded by a large mass of water, or placed in a cavity in a block of paraffin wax. In this way, full advantage was taken of the now well-known methods of slowing down and absorbing neutrons.

Amongst the chemical actions investigated have been the oxidations of potassium metabisulphite and sodium bisulphite, and the decomposition of hydrogen peroxide. In each case it was found that the action provoked by a pure γ-ray source was increased by using a source of equal strength which also emitted neutrons.

The following colloids have been investigated: Hydrosols of silver and gold, the sulphides of arsenic and cadmium, and vanadium pentoxide and ferric hydroxide. When prepared in the standard way it was found that a source emitting both neutrons and γ-rays increased the stability of the negatively charged colloids and decreased the stability of the positively charged colloids. A similar but definitely smaller effect was obtained with pure γ-ray sources of the same strength. Anomalous results could, however, be obtained when foreign electrolytes were intentionally added to the colloidal sol before irradiation.

In all the actions outlined above, it was found that the effect which must be attributed to the neutrons alone, was of the same order of magnitude as that due to the γ-rays alone. The greater efficiency of slow neutrons in producing these effects is strikingly exhibited, since with the sources used approximately one neutron was produced per hundred thousand γ-ray quanta emitted. So far as we are aware, no previous observations of the effect of neutrons on chemical reactions or colloidal stability have been published.

This investigation was begun in the hope of discovering a method of detecting neutrons which would be independent of the usual techniques of inducing radioactivity or the use of electrical counters. Two methods, which possess the great advantage of integrating the effects produced until they are easily measured by standard chemical methods, are indicated above.

The similarity of the effects due to neutron and γ-ray irradiation would seem to indicate that the commonly accepted views on the mode of action of the latter are in need of revision.

A fuller account of this work will be published shortly.

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Production of Cosmic Ray Showers at a Considerable Depth below Ground-Level

IN order to find whether showers are produced by the penetrating cosmic rays which reach considerable depths below ground-level, we have performed experiments in Holborn Underground station (by permission of the London Passenger Transport Board) at a depth corresponding to 60 m. of water. The vertical intensity of the radiation at this depth, as measured by the rate of occurrence of coincidences between three counters in a vertical plane, is about one-fifteenth that at ground-level. To count showers we used five counters, arranged in a pentagon formation, so that at least three particles are needed to discharge the five counters simultaneously. The occurrence of coincidences is therefore in itself definite proof of the presence of showers. The quintuple coincidence method is preferable to the triple coincidence method as usually used hitherto, as in the latter case a coincidence can be produced by two particles. The presence of showers can then be proved only by showing that there is an increase in the rate of occurrence of coincidences when a sheet of, say, lead is placed over the counters, the dimensions and disposition of the lead being such that coincidences due to particles originating in it must be due to at least three particles. The detection of showers then entails the establishment of a difference between rates with and without the lead, and these may be nearly equal.

Our preliminary results have shown that (*a*) showers are produced in the earth above the counting apparatus; (*b*) the shower rate is increased several fold when the group of counters is surrounded by lead; (*c*) the thickness of lead for maximum shower production is about 1·6 cm., that is, about the same as at ground-level; (*d*) for this thickness the ratio of the rate of shower production to vertical intensity is not very different from that at ground-level under the same conditions.

These conclusions are not in agreement with those of Auger[1], who has reported the absence of showers under 8 m. of earth; or those of Pickering[2], who has reported a rapid diminution in the ratio of the rate of shower production to intensity at depths down to 10 m. of water. The difference seems to be explicable in terms of the counter dispositions used in the various cases, and we shall discuss this point when our results are published in full.

Since there is good reason to believe that protons, owing to their large mass, should produce very few showers, we can conclude from our results that a considerable part of the radiation which penetrates 60 m. of water must consist of positive or negative electrons.

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Dec. 5.

[1] Auger et Berlein, *J. Phys.*, 6, 253; 1935.
[2] Pickering, *Phys. Rev.*, 47, 423; 1935.

Influence of the Velocity of Slow Neutrons on their Capture by Certain Nuclei

WE have tried to measure the dependence of the cross-section of protons for absorption of neutrons on the relative velocities of these particles. A method which allows of the determination of the absorption of slow neutrons by paraffin wax was used[1]. A source of neutrons (radon + beryllium) was placed in the middle and a silver plate at one end of a cylinder of paraffin wax (4·5 cm. diameter, 18 cm. long). This end could be dipped 5 cm. deep in liquid oxygen. A screen of cadmium could be interposed at different distances between the source and the silver.

The intensity of activation of the silver obtained at room temperature was plotted against the distance between the silver and the absorbing cadmium screen. A curve was obtained, which showed that the diminution of the activity of the silver, due to interposing the cadmium screen, decreased to a half when the distance between the silver and the absorber was increased by 1·6 cm. This shows that, in the given geometrical circumstances, 50 per cent of the slow neutrons, which are absorbable in cadmium, are absorbed or scattered out of the wax cylinder after diffusion through 1·6 cm. of paraffin. Cooling the end of the cylinder to 90° K. increased the activity of the silver, but had no effect on the thickness of the layer of paraffin wax required to reduce the slow neutrons to 50 per cent. This shows that the cross-sections of protons for elastic scattering and for absorption of neutrons are not much increased when the neutrons are slowed down below the velocity they obtain in paraffin wax at room temperature. This seems contradictory to the theory of capture of neutrons by protons[2]. Mr. Francis Perrin and Mr. Walter M. Elsasser, who kindly discussed this result with us, think it compatible with theory for the following reason. The protons in paraffin wax have, in consequence of the total degeneration of the C–H vibration, always a minimum velocity which is large compared with the thermal velocity at room temperature. The relative velocity between a neutron and a proton is therefore changed by a smaller factor than $\sqrt{T_1/T_2}$ when the temperature of the wax is changed from T_2 to T_1. ($\sqrt{T_1/T_2}$ is 1·78 for our case; a change of cross-section of less than 15 per cent would not have been observable.)

Moon and Tillman[3] have shown that neutrons slowed down by paraffin wax are more capable of activating silver and rhodium, when the wax is cooled down to 90° K., but less efficient for iodine. When repeating these experiments, we found the same increase for the activation of silver (28 ± 5 per cent) but an increase of about 10 per cent instead of a decrease for iodine. It might be expected that the cross-section of most nuclei for the capture of slow neutrons would be inversely proportional to the relative velocity between the capturing nucleus and the neutron. In this case, the increase of activation should be 78 per cent for cooling down to 90° K. Moon and Tillman have suggested that not all the neutrons capable of activating silver are already in thermal equilibrium with the protons of the paraffin wax. If the probability for the capture of neutrons by silver be proportional to $1/v$ (v being the velocity of the neutrons relative to the silver atoms), neutrons of energy higher than kT might still give an appreciable contribution to the activation of silver. But cooling the diffusing paraffin would have no big influence on the velocity of these neutrons, and the total activity would therefore be increased by a smaller factor than $\sqrt{T_1/T_2}$.

We observed that the activation of silver by neutrons which had diffused through paraffin was independent of the temperature of the latter when 2 mm. of cadmium was placed directly in front of the silver. It thus seems possible to distinguish at least roughly the neutrons which are still capable of activating silver—although with a small probability—but have a higher energy than kT, from those the energy of which is on the average kT. If the activations above this background, which is independent of the temperature and of the thickness of the cadmium screen in front of the silver, are compared, the activity obtained at 90° K. was 70 per cent higher than that obtained at room temperature. This result indicates that the cross-section for the capture of neutrons by silver nuclei is actually proportional to $1/v$.

For thin cadmium screens a dependence of the absorption coefficient on the velocity of the neutrons was found. These results will be published later.

PETER PREISWERK.
HANS VON HALBAN, JUN.

Institut du Radium,
Laboratoire Curie,
Paris.
Nov. 22.

[1] Hans von Halban, Jun., and Peter Preiswerk, [NATURE, 136, 951; 1935.]
[2] E. Fermi, *Phys. Rev.*, 48, 570; 1935.
[3] M. B. Moon and J. R. Tillman, NATURE, 135, 904; 1935.

Redetermination of the Soludility of Chloropentammine Cobaltic Chloride

RECENTLY, I had occasion to describe an improved method for the purification of chloropentammine cobaltic chloride, and to note that the product behaved differently from that obtained by the older method, in that it passed into solution much more rapidly[1]. For this reason, and as previous measurements[2] are not very concordant and may in some cases have been carried out with impure materials, a redetermination of the solubility seemed of interest.

Experiments were carried out at 25·00° and at 0·20°; the salt was violently stirred with water and samples were taken every half-hour or so by means of a pipette fitted with a small sintered-glass filter, until a constant composition was reached. Analyses were carried out by volumetric determination of chloride after decomposition with alkali.

In the experiments at 25°, the influence of the conditions of precipitation was studied by measuring the solubilities of specimens which had: (*a*) been precipitated quickly in the cold from water solution by HCl; (*b*) been heated for some hours under HCl after precipitation in the cold; (*c*) been slowly precipitated on the water-bath from a solution of pure roseo-chloride in presence of excess HCl. No appreciable difference in the final solubilities could be detected.

The solubilities found were, in mols/litre, at 25·00°, 0·0211; and at 0·20°, 0·00925. When plotted (log s against $1/T$) these results are found to agree well with those of Bronsted and Peterson, but not with the other determinations.

Mention should be made of the possible effect of aquotisation in the course of the experiment. This takes place at 25° to the extent of about 0·6 per cent per hour, and means that the saturated solution

contains a little excess chloride ion and a little less purpureo-ion. It is easy to show, however, that if the mass-law may be assumed for the small range concerned, the two corrections mutually cancel, and the *total* (including non-ionisable) chlorine concentration in the solution is constant. In practice, once equilibrium had been attained, no variation with time of the solubility as measured could be detected.

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[1] Garrick, *Z. anorg. Chem.*, 224, 27; 1935.
[2] Lamb and Simmons, *J. Amer. Chem. Soc.*, 43, 2196; 1921. Bronsted and Peterson, *J. Amer. Chem. Soc.*, 43, 2269; 1921. Ephraim, *Ber.*, 56, 1531, 1923.

Flame Speeds during the Inflammation of Moist Carbonic Oxide–Oxygen Mixtures

IN 1932[1] we found that the mixture of carbonic oxide and oxygen which gave the maximum speed of flame during the 'uniform movement' was approximately that for combining proportions ($2CO + O_2$), in accordance with the theory advanced earlier[2]. This conclusion is supported by recent experiments carried out at the U.S. Bureau of Standards by Fiock and Roeder[3], using two different methods for measuring the speed of flame, with central ignition (*a*) in a closed sphere and (*b*) in a soap bubble. The concentration of moisture was carefully measured and kept constant in each series (a necessary precaution which we emphasised in our paper), but differed in the two series, being 2·7 and 3·3 per cent.

Fiock and Roeder's results are of further interest in that they show a slight but distinct displacement of the maximum speed towards a mixture containing an excess of carbonic oxide. This effect can be explained as being due to the moisture present in the mixtures taking part in the combustion, so that there are simultaneous reactions:

$$2CO + O_2 \rightarrow 2CO_2$$
$$CO + H_2O \rightarrow CO_2 + H_2,$$

and the displacement should be greater the higher the concentration of water vapour. Fiock and Roeder's experiments indicate that this is so; our own experiments, which gave no evidence of a displacement, were made with mixtures containing only 1·6 per cent of water vapour.

W. PAYMAN.
R. V. WHEELER.

Safety in Mines Research Board,
Research Laboratories,
Sheffield, 1.
Nov. 30.

[1] *J. Chem. Soc.*, 1835, 1932.
[2] *J. Chem. Soc.*, 48; 1920.
[3] Nat. Advis. Com. Aeronautics, Report No. 532, 1935

Effect of Adsorbed Water on the Catalytic Decomposition of Hydrocarbons (by a Molecular Beam Method)

BY using true molecular beams of various hydrocarbons projected on to a platinum filament (4 mm.^{2} heated area) of known and controllable temperature, we have studied the primary decompositions instantaneously by pressure variations in the filament chamber, which is large compared with the filament. Similar decompositions at a carbon surface have also been studied, the carbon surface consisting of a thin layer of carbon deposited on platinum by heating a strip of the latter in a hydrocarbon atmosphere. Some preliminary results were briefly reported at the meeting of the American Physical Society in June, 1934[1]. The inhibiting effects then ascribed to hydrogen are actually due to water.

It has been conclusively shown that in both cases —the bright platinum filament and the carbon filament—no dehydrogenation of paraffins, olefines or alcohols takes place unless traces of water are present in the vapours concerned. We postulate that this water is necessary to maintain a monomolecular layer of water molecules on the catalytic surface, and that this layer is the true seat of dehydrogenation. The dehydrogenation is inhibited by an excess of water on the foil in the lower temperature region. Thus the temperature at which the reaction falls off is dependent on the water content of the gas investigated. This phenomenon makes it impossible to follow the uninhibited course of the reaction into lower temperature regions. Traces of air in the presence of traces of water do not affect any of these reactions.

Under favourable conditions, the dehydrogenation is within the limits of experimental error complete over temperature ranges of several hundred degrees centigrade. This must mean that the promoting water layer is adsorbed on the surface in a different manner from the inhibiting layers. Therefore, we can draw interesting conclusions regarding the adsorption of water at high temperatures and the heat of activation of the dehydrogenation process itself. If the filament is heated to about 1550° C., at which temperature all adsorbed vapours are driven off (slight carbon formation on the surface cannot under these conditions be prevented), the pressure in the reaction vessel drops to zero in all cases tested except that of methane. This complete disappearance of all incoming molecules leads to the conclusion that free radicals are formed by rupture of C–C bonds and that the reaction products are readily adsorbed on the walls of the reaction vessel.

The investigation of the decomposition of methane is not yet concluded, but the fact that at temperatures above 1550° C. the pressure in the reaction chamber is only slightly diminished, favours the assumption of a decomposition of methane into the methylene radical and a hydrogen molecule. The assumed decomposition of all other hydrocarbons into free radicals upon collision with a completely degassed surface at high temperatures can likewise be shown to take place at temperatures several hundred degrees lower when the measurement is performed immediately after degassing the foil at temperatures above 1550° C. In these cases the slow covering of the foil first with a dehydrogenation promoting layer followed by further adsorption layers inhibiting all reaction may be easily followed.

The experimental evidence that the dehydrogenation takes place only in the presence of a promoting mono-molecular water layer on the catalyst alters this catalytic problem fundamentally, since from the theoretical point of view both the mode of adsorption of water and the dehydrogenation reaction proper in presence of the adsorbed water layer have to be considered. The latter may very likely be interpreted as an interaction between the carbon-hydrogen bonds of

the hydrocarbon and the activated hydrogen-oxygen bonds in the adsorbed state.

We have experimental evidence that the water may be substituted by certain other molecules having hydrogen bonds with electronegative elements, for example, hydrogen sulphide.

Since then, we have started experiments by a different method to study the effect of water on the reverse process, the hydrogenation of unsaturated hydrocarbons. The outcome of these preliminary experiments apparently shows that the presence of water is equally important for the hydrogenation process. A hypothesis that adsorbed water plays a vital part in the hydrogenation process was advanced by Boswell[2] in 1922, based on the study of the reduction of nickel oxide by hydrogen as well as the catalysis of the hydrogenation by partially reduced nickel oxide. The great difficulties of proving this hypothesis quite conclusively in the case of the hydrogenation seem to have led to it receiving little attention.

The first part of a detailed account of this work containing the experimental method and the results with paraffins will be submitted for publication in the *Proceedings of the Royal Society* at an early date.

Grateful acknowledgement is made to the directors of the Shell Development Company and especially to Dr. E. C. Williams, for their continuous interest in this work and their permission to publish it.

OTTO BEECK.

Shell Development Company,
53rd and Horton Streets,
Emeryville, California.
Nov. 13.

[1] *Phys. Rev.*, **46**, 331; 1934.
[2] M. C. Boswell, "The Mechanism of the Catalysis of Hydrogenation by Nickel", *Trans. Roy. Soc. of Canada*, Sect. 3, **16**, 1, later extended to platinum, *ibid.*, **17**, 1.

Endocrine Organs of the Blue Whale

As nothing seems to have been published in the literature on the hormone-producing organs in the whale, I submit a short communication of the preliminary results[1] of my investigations on the subject. The endocrine organs were collected by me during a whaling expedition to the Antarctic. They were preserved in a frozen or dried condition or by means of alcohol for four to ten months before examination.

The *anterior lobe of the pituitary gland* in the blue whale weighs about 30 gm. I have been able to demonstrate the presence of the follicle-stimulating, luteinising, thyreotropic and lactogenic hormones.

The *thyroid gland* in the blue whale weighs about 6–8 kgm. In a dry powder prepared from it was found an average iodine content of 2·03 per mille. The powder produces an increase of metabolism.

The *pancreas* of the blue whale weighs about 50–80 kgm. After being preserved in the frozen state for about five months, it will yield by extraction 500 international units of insulin a kilogram.

The *ovary* in the blue whale weighs 4–5 kgm. The quantity of follicular fluid that can be drained from one ovary is about 500 c.c. It contains about 2,000 mouse units of œstrogenous substances a litre.

The *corpus luteum graviditatis* may, in the blue whale, weigh up to 4 kgm. After having been preserved in a frozen state for a year, it still contains considerable quantities of progestin, namely, at least 60 rabbit units a kilogram.

Quantitative investigations have hitherto been carried out only with the pancreas and the ovary.

A complete and detailed description of the experiments and their results will be published later.

ALF P. JACOBSEN.

Physiological Institute,
Royal University,
Oslo. Nov. 27.

[1] Alf P. Jacobsen, *Tidsskrift for den norske Lægeforening*, Nr. 5; 1935.

Swarming of *Odontosyllis phosphorea*, Moore, and of other Polychæta near Nanaimo, B.C.

IN his very interesting article on the "Possible Bearing of a Luminous Syllid on the question of the Landfall of Columbus" in NATURE of October 5 (p. 559) L. R. Crawshay mentions the swarming of *Odontosyllis phosphorea*, Moore, in this neighbourhood. He refers to the observations made by Potts[1] in 1911, from which it was inferred that there was a periodicity in the appearance of the swarming forms of the species in Departure Bay, and that this could be correlated with the phases of the moon.

As a result of much more extended observations of the actual state of affairs in 1914, it was shown by Fraser[2] that there is no such periodicity, and that swarming forms of both sexes may be taken on any day over a period of between three and four months provided the water is still at sundown, at which time, exclusively, swarming occurs. In more recent years, I have had many opportunities of confirming Fraser's observations, and swarming forms have been taken at dates both earlier and later in the year than recorded by him. It is interesting to find this difference in the behaviour of *O. phosphorea* from that of both *O. enopla*, Verrill, as recorded by Galloway and Welch[3] and of the Bahamian species, as now described by Crawshay.

The swarming form of *O. phosphorea* has not yet been taken at any point in this neighbourhood far distant from that at which it was observed by Potts and Fraser, but there is little doubt that this is due to the lack of sufficiently intensive search, since the area of distribution of the atokous form has now been so extended as to indicate that it is quite general in the Strait of Georgia. The conditions in Departure Bay are, due to its sheltered situation and to the set of the currents into it from around the adjacent islands, particularly favourable to finding epitokous polychætes and, as Fraser points out, these factors are, no doubt, partly responsible for the concentrations of swarming *O. phosphorea* which occur at the entrance to the bay.

It would, perhaps, be of interest in this connexion to record other species the epitokous forms of which have been taken in Departure Bay in recent years. These include *Autolytus prismaticus*, Fabricius, *Syllis elongata*, Johnson, *Syllis armillaris*, Müller, *Syllis borealis*, Malmgren, *Autolytus magnus*, Berkeley, *Nereis virens*, Sars, *Platynereis Dumerilii* (Aud. M-Edwards) var. *Agassizi*, Ehlers, *Nereis pelagica*, L., *Nereis vexillosa*, Grube, *Glycera nana*, Johnson, *Armandia brevis*, Moore. All these have been taken at or near the Station float at various seasons and at various times of day and night.

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[1] *Proc. Camb. Phil. Soc.*, **17**, Pt. 2; 1913.
[2] *Trans. Roy. Soc. Canada*, **19**; 1935.
[3] *Trans. Amer. Micr. Soc.*, **30**; 1911.

Records of Fatalities from Falling Meteorites

WITH reference to Mr. M. A. R. Khan's letter in NATURE of October 12, p. 607, on the above subject, I would point out that Col. G. H. Saxton's letter[1] regarding the Nedagolla meteorite of January 23, 1870, states that of the people in the village, who were greatly alarmed, "some received violent shocks and a man near to whom it fell, was stunned". Apparently the man was not hit, but was stunned by the air pressure.

In the original account[2] of the Mhow meteorite, also referred to by Mr. Khan, it is stated that the largest fragment weighed three pounds, and fragments were picked up four or five miles apart; "one broke a tree, and another wounded a man severely in the arm". However, the authority for the statement is not given and in default of substantiation, it is best, like "The Writer of the Review", to accept Prof. Heide's statement.

Mr. Khan should refer to my account[3] of the Naoki meteoric shower of September 29, 1928, to which his[4] is supplementary.

A. M. HERON.

Geological Survey of India,
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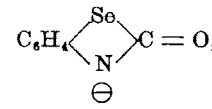
Nov. 4.

[1] *Proc Asiat. Soc. Beng.*, pp. 64–65; 1869.
[2] *Edin J. Sci.*, 9, 172, 1828.
[3] *Rec. Geol. Surv. Ind.*, 62, 444–451; 1930.
[4] *J Osmania Univ. Coll*, 2, 22–23; 1934.

Absorption Spectra of Tautomeric Selenazoles

THE ultra-violet absorption curve of 1-hydroxyl benzselenazole in methyl alcohol is almost identical with that of 1-keto-2-methyl-1 : 2-dihydrobenzselenazole, and quite distinct from that of the *o*-methyl ether. In aqueous sodium hydroxide solution, the curve of the hydroxyselenazole is shifted to the left (deformation), and there is a decrease in maximum due to the production of the ion



on which tautomeric change depends.

1-Thiolbenzselenazole also shows a striking similarity to thiazole analogues in the ultra-violet region, the curve in methyl alcohol being closely similar to that of 1-thio-2-methyl-1 : 2-dihydrobenzselenazole. The absorption curve for the thiolselenazole in aqueous sodium hydroxide belongs to the same family, but shows a slight shift towards the region of shorter wave-length, and an appreciable drop at the first maximum on account of the removal of mobile hydrogen.

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Points from Foregoing Letters

TAKING as variables the "preparedness for war", "defence coefficients", "fatigue and expense coefficients", and "dissatisfaction with treaties", Dr. L. F. Richardson expresses by means of differential equations the tendency towards war or peace. He deduces that the international system is unstable if the product of the two defence coefficients exceeds the product of the two fatigue coefficients and may drift either towards war or co-operation, according to the value of the different constants in the equations.

The effect of gamma-rays and of neutrons upon colloidal dispersions (gold and silver, arsenic and cadmium sulphides, vanadium pentoxide, ferric hydroxide) and upon chemical reactions (oxidation of potassium metabisulphite and decomposition of hydrogen peroxide) has been investigated by Prof. F. L. Hopwood and J. T. Phillips, with the view of obtaining a method for the detection of neutrons, not dependent on the formation of radioactive substances, which are variable with time. They have detected an effect upon the chemical reactions and also changes in the stability of the colloidal dispersions.

Experiments carried out below ground at a depth equivalent to 60 m. of water, by D. H. Follett and J. D. Crawshaw, show that cosmic rays which penetrate to this depth have, proportionately, the same ability to produce electron showers as those at the earth's surface, thus indicating that they consist of positive or negative electrons. These findings are not in agreement with those of previous investigators, who have reported rapid diminution of the ratio of the rate of shower production, or even complete absence of showers, at lesser depths.

The radioactivation of silver by neutrons at different temperatures and after traversing different thicknesses of paraffin (with a cadmium shield interposed at various distances) has been investigated by Drs. P. Preiswerk and H. von Halban, Jun. They find, in accordance with Fermi's theory, that for silver nuclei the chance of capture varies inversely as the relative velocity of nucleus and neutron, when account is taken of the velocity of thermal neutrons; this result does not hold for collisions of neutrons with the hydrogens of paraffin wax. The authors further find, unlike Moon and Tillman, that cooling the paraffin wax to 90° K. increases by 10 per cent the radioactivity induced in iodine.

The catalytic dehydrogenation of alcohols, paraffins and olefines at a hot platinum or hot carbon surface has been studied by O. Beeck by means of a molecular beam technique. He finds that a monomolecular layer of water is necessary in order to render the surface catalytically active, and that for all cases except methane the primary reaction is a splitting into free radicles (methane splits to free methylene and molecular hydrogen). At lower temperatures an excess of water inhibits the reaction. Water is, apparently, also necessary for the reverse (hydrogenation) reaction.

The presence of various hormones in the thyroid and pituitary glands, pancreas, ovary and corpus luteum of the blue whale has been ascertained by Dr. A. P. Jacobsen.

In connexion with Crawshay's recent suggestion that a phosphorescent syllid may have been responsible for the light "like the flame of a small candle" observed by Columbus after sunset on approaching the American shores, E. Berkeley gives further particulars of the swarming habits of *Odontosyllis phosphorea* at Departure Bay, B.C.

Research Items

Gallo-Roman Official in Early Britain

A RECENT accession to the British Museum (Bloomsbury) collections has enriched the Museum with a closely dated inscription of an interesting historical figure, and made possible a restoration of one of the most important sepulchral monuments surviving from the Roman Province of Britain. For more than eighty years, the Museum has possessed two stones from what must have been one of the most imposing sepulchral monuments of London, which had been dated tentatively as late first century or early second century of our era. One is a 'bolster' with imbricated leaves and central binding; the other bears the beginning of an inscription and is 2 ft. 6 in. in height and more than five feet long as found. Owing to the rarity of the name 'Classicianus' appearing in the mutilated inscription, some reserve was shown in attempting any solution of the problems of meaning and purpose. These stones had been found in 1852 built into one of the semi-circular bastions added in later Roman times to the walls of the city of London. They were found in Trinity Square, Minories. A small portion of the bastion survived until June 1935, when it was brought to light by the enlargement of the Minories Sub-station. An inscribed stone was then discovered upside down in the lowest course of masonry. This has now been presented to the Museum and identified as part of the Classicianus monument. In a description by Mr. C. F. C. Hawkes (*Brit. Mus. Quarterly*, 10, 2) it is pointed out that the stone had already been re-used before it was built into the bastion. It is suggested that the mortuary inscription, so far as now restored, points to this Classicianus being identical with the official of that name mentioned by Tacitus as taking over the procuratorship of Britain on the death of Catus Decianus in A.D. 61, the year of Boudicca's rebellion, and that his names indicate that he was probably a native of Gallia Comata—an interesting example of the tendency noted by Tacitus for natives of Gaul to occupy office even at this early date.

African Bark Canoes

MR. JAMES HORNELL describes and figures in *Man* of December a bark canoe which he saw on the shore in the native quarter of Mozambique in 1926, comparing it with a similar canoe recently described from the Pungwe River in Northern Rhodesia The Mozambique example represents a great advance upon the Pungwe design. Instead of being made from a continuous length of bark stripped from one tree and sewn into shape without any internal framework, its construction was rather on the model of a sea-going Irish curragh, except that it was sharp at both ends, whale-boat fashion. The bottom was rounded and the sides had a distinct tumble-home form. The framework consisted of a large number of closely set transverse frames made of bamboo poles, bent into a wide U-shape. They were held in position and stiffened by two pairs of stout bamboo poles running longitudinally on the floor, each pair lashed about nine inches on either side of the median line; while another pair on each side formed a rude, but efficient, gunwale. A single lighter bamboo was made fast to the ribs on each side, four or five inches below the gunwale. Five stout plank thwarts strengthened the framework transversely. Their ends were inserted beneath and hidden by the gunwale bamboos, to which they were fastened by stout cord passed through two holes made in each thwart end. A median hole in the midships thwart, and a hole in a short wooden bar on the floor below, showed that the canoe could be used for sail. The bark skin was sewn together in long thick sheets by palm-fibre cord. Where the bark sheets met at each end, they were sewn together at a considerable distance from the edges, the free ends acting as a fender and protecting the sewing. The sides were made of several lengths of bark, with an overlap. The bark skin was sewn to the gunwale by double stitches at short intervals with a single connecting cord running along the outside. The canoe was about fourteen feet in length with an extreme beam of four feet.

An Interesting Habitat for Copepods

IN a paper entitled "A New and Important Copepod Habitat" (*Smithsonian Misc. Coll.*, 94, No. 7, 1935), C. B. Wilson discusses the occurrence of copepods in the spaces between the sand grains of beaches, which he terms "terraqueous", and compares them with free-swimming, commensal and parasitic copepods. Such copepods, he states, are widely distributed in quartz sand, but are seldom found in coral sand and never in 'sand' composed of shell fragments, in which the interstices may be greatly reduced or absent. They occur, however, in mud, where the surface layers are more or less flocculent. They show a wide distribution within any given area of sand, occurring from high to low water and even below low water. Individual species usually show a restricted distribution within a given area, and species change not only from one bay or sand-bank to the next, but also with change in level from high-water downwards. Owing to the nature of the habitat, copepods inhabiting such a region are of minute size, seldom attaining a length greater than 0·5 mm. (in sand), and are usually many times longer than broad, the elongate shape being a necessary modification due to the habitat. This elongation is accompanied by increased flexibility, essential for movement in such surroundings. There is a large development of sensory setæ on the antennules. At the same time, as Remane has pointed out (*Wiss. Meeresuntersuch.*, Kiel, 21, Pt. 2, 1933), there may be a reduction in the development of the eyes, analogous to that of the fauna of caves. These features may both be correlated with the habitat. It is interesting to note that members of the three chief groups of copepods are represented in this fauna, even Calanoids, though the majority appear to belong to the Harpacticoida, and all show the same type of modification in body structure. Owing to its inaccessibility by ordinary dredging methods, this fauna has remained undiscovered until the last few years, during which a large number of new genera and species of copepods and other animals has been described by W. Klie (*Zool. Jahrb. Syst.*, 57, 1929), C. B. Wilson (*U.S. Nat. Mus. Bull.*, 158, 1932) and others.

Structure of *Ctenoplana*

DR. TAKU KOMAI (*Mem. Coll. Sci., Kyoto Imp. Univ.*, B, 9, No. 4, Art. 6; 1934) describes a specimen of *Ctenoplana* found with a second individual attached to drift seaweed near the Misaki Marine Biological Station. This peculiar creeping ctenophore is very rare and extremely interesting. It is closely related to *Cœloplana*, sharing with it the creeping sole, pigment, branching canals, compact testes, spermiducts, processes of polar plates and the absence of pharyngeal canals. It differs, however, in being much smaller, the ribs persisting, the musculature far less developed and the finger-like processes of the polar plates better differentiated than in *Cœloplana*. These differences are apparently correlated with the swimming and creeping habit, whilst *Cœloplana* is limited to creeping life in the adult stage. There is a close resemblance between *Ctenoplana* and the larvæ of *Cœloplana* which has been already pointed out by Dawydoff. There are, however, differences in the gastro-vascular system, which is far better differentiated in *Ctenoplana*, and in the disposition of the tentacular apparatus—vertical in *Cœloplana* larvæ and horizontal in *Ctenoplana*.

Cultivation of the Walnut

DR. JOYCE B. HAMOND, of the East Malling Research Station, contributes a paper on "Recent Developments in Walnut Growing in England" to the *Journal of the Royal Horticultural Society* for November. This account brings together the results of many original investigations. It may be claimed that the present satisfactory state of walnut culture in Great Britain is largely due to the efforts of research workers whose interest was primarily academic. Ten years ago, the walnuts of this country were poor in taste, unpleasing in colour, often covered by a gaping shell, and altogether unattractive. Then Mr. Howard Spence determined to improve the nut. His own work and wider stimulation laid the foundations for the investigation of methods of propagation by Mr. A. W. Witt, the study of graft diseases and methods of storage of nuts by Miss Hamond, and the control of bacterial blight by Dr. H. Wormald. These aspects are described with detail in the paper under review. Four nursery firms have now taken over the stock of improved trees raised by the East Malling Research Station. These are grafted upon standardised rootstocks, produce well-flavoured fruit of good taste, and are phenologically adapted to the English climate. Grafting of walnut trees is discussed, and bush specimens of this crop may be obtained by merely removing the tips of any shoots which tend to increase in length too vigorously. Miss Hamond shows how the nuts may be bleached and stored in coco-nut fibre mixed with salt. The would-be grower is provided with full information for production of nuts of the highest quality, and the account should go far to popularise the improved walnut as a crop, and extend its cultivation.

Stripe Disease of Daffodils

A DISEASE of daffodils where the leaves become mottled with yellow patches has attained rather serious proportions of late years. Various causes, ranging from 'inherent weakness' to the effects of soil and climate, have been propounded in the past, but it is now realised that a virus is responsible for the malady. Mr. N. K. Gould (*J. Roy. Hort. Soc.*, Nov.) describes a number of experiments upon the incidence, transmission and control of the disease. The Poetaz and Tazetta sections of the Narcissæ are completely free from stripe or mottling, but the other groups can be kept free from the trouble only by the strict removal of infected plants. Treatment with hot water for three hours—the normal precaution against eelworm—has no effect, either in transmitting or inactivating the causal agent. The virus is quite unaffected by treatment with fourteen disinfectants mentioned in the paper, and has not been transmitted from diseased to healthy plants by grafting or by needle inoculations.

Sooty Mould Fungi

MISS LILIAN FRASER, Linnean Macleay fellow of the Linnean Society of New South Wales, is making a detailed study of the peculiar aggregations of fungi known as sooty moulds. These usually consist of a member of the Capnodiaceæ, a species of *Atichia*, and a third organism belonging to Fungi Imperfecti. Three new papers have been contributed to the *Proceedings of the Linnean Society of New South Wales* (60) during the present year, and represent the third, fourth and fifth of the whole series. Part 3 (pp. 97–118, May 1935) describes "The Life Histories and Systematic Positions of *Aithaloderma* and *Capnodium*, together with Descriptions of New Species". Life-histories of four fungi are considered in detail, and three which are described for the first time are *Capnodium salicinum*, Mont., var. *uniseptatum*, *Aithaloderma ferruginea* and *A. viridis*. Much technical discussion of the systematic position of these fungi is included, and it is held that the Capnodiaceæ, as represented by *Capnodium* and *Aithaloderma*, should be included in the Dothideales. "Species of the Eucapnodieæ" is the title of the fourth part (pp. 159–178, Sept. 1935), which adds six new species and varieties. Amended descriptions of the incompletely known species *Capnodium Walteri*, *C. fuliginodes*, *C. anonæ* and *C. mucronatum* are given, and *Scorias philippinensis* is now recorded from Australia for the first time. Part 5 (pp. 280–290, Sept. 1935) is entitled "Species of the Chætothyriaceæ", and therein eight new species of this subsection of the Capnodiaceæ are described in detail. The taxonomic conclusions of all three papers are based upon adequate culture experiments, and the series should go far towards an elucidation of the complexities of the commonly occurring sooty moulds.

New Current-Measuring Apparatus

FOR the last ten years or more, there have been in existence various types of continuous current meters for the direct measurement and automatic recording of the speed and direction of water flow past lightships and other moored vessels. Such meters are mainly fine-precision instruments, and therefore quite unsuitable for use in exposed positions during periods of severe storm. This has been a very serious drawback, for data relating to bad weather conditions are highly important from the biological point of view. In order that such data may in future become available for fishery research workers and others, Dr. J. N. Carruthers, of the Fisheries Laboratory, Lowestoft, has recently devised a simple, cheap and very sturdy current-measuring apparatus to which he has given the name 'Vertical Log' (*J. Con. Internat. Explor. Mer*, 10, No. 2, 151–168 (1935)). The instrument, it is claimed, will

work continuously in very exacting conditions indeed. It is, however, not automatic in point of direction recording, but requires fleeting attention—often not more than a glance—every now and again. As experience in its use is acquired, it often becomes possible to leave the apparatus unread for several hours on end; at other times it will call for brief inspection every quarter-hour or so. It can be worked equally well from both wooden and steel ships and at all depths. The makers, Messrs. Elliott and Garrood, of Beccles, Suffolk, estimate that, after the first few instruments have been supplied, they will be able to make further 'logs' of this type at a cost of about £12 each. We hope that this new current meter will fully justify the high hopes of its inventor.

Noise Limitation in Valve Amplifiers

IT is now well recognised that the chief factor which limits the amplification obtainable by means of thermionic valves is the electrical noise generated within the amplifier itself. It is not practicable to amplify any electrical signal unless the input voltage of this signal is greater than the electrical noise voltage developed in the early stages of the amplifier. The fundamental limiting sources of this noise are two, namely, thermal agitation of electricity in the input circuits and the voltage fluctuations within the valves themselves. The first of these, thermal agitation, is now fairly well understood and is actually used as a source of calibrating voltage in certain types of receiving and field measuring equipment. The second noise arises from the fact that the space current in a valve is not smooth, but is subject to rapid and irregular fluctuations in magnitude. This matter is discussed in an article by G. L. Pearson entitled "Quiet Amplifier Tubes" published in the October issue of the *Bell Laboratories Record*. The output noise of a valve amplifier due to the intermittent nature of the electron current has been measured for a variety of valves and over a wide range of frequencies. In order to reduce the noise to a minimum under conditions of high signal amplification, it was found that, in general, the valve cathode must be operated at as high a temperature as possible, without impairing the life of the valve. Also the negative bias of the control grid must be reduced to as near zero as possible without causing excessive grid current, while the anode and screen voltages must be reduced below the values normally recommended. Expressing this electrical noise as an equivalent input voltage, the value was found to vary between limits of about 0·7 and 1·5 microvolts for a selection of fifteen American valves. In general, the triodes gave a lower value than the multi-grid valves. At low audio frequencies, this noise is inversely proportional to the frequency, but it remains approximately constant for frequencies above one or two thousand cycles per second.

Toxicity of Cod Liver Oil

THE use of synthetic diets composed of the individual nutrient constituents in purified form has contributed largely to our modern knowledge of nutrition. Purified diets for Herbivora present special problems in that these animals normally consume rations containing large amounts of cellulose, and studies have been conducted on this subject by L. L. Madsen, C. M. McCay, and L. A. Maynard (Cornell University Agricultural Experiment Station, Memoir 178, 1935). After trials, a regenerated cellulose known as washed 'Sylphrap' was adopted as the cellulose constituent, and the diet devised which proved successful in maintaining an adult goat over an extended period consisted, in percentages, of cellulose 30, corn starch 30, casein 15, sucrose 10, yeast 7, salt mixture 5 and lard 3, with the addition of about 1·6 per cent of cod liver oil. Sheep thus reared from weaning were successfully maintained for 480 days, similarly goats though not quite so satisfactorily, and less success was achieved with guinea pigs and rabbits. In the last-named, and to some extent with goats, eventual failure was due to the development of paralysis dependent upon muscular degeneration. It was demonstrated that the cod liver oil was the essential agent causing this lesion, which ensued unless the cod liver oil ration was kept below 0·1 gm. per kilo of live weight. As the authors are careful to state, the results, while furnishing no evidence applicable to the human species, should serve to direct further attention to the reports of Agduhr and others describing similar lesions in infants as being caused by cod liver oil.

New British Standard Glue Tests

THE British Standards Institution has just issued a series of British standard methods for the testing of bone, skin and fish glues. The tests laid down include methods for the determination of moisture content, jelly strength, viscosity, melting point, foam, water absorption, keeping quality, joint strength in shear, reaction, grease, ash, sulphur dioxide and chlorides. The relative importance of the tests described must necessarily depend largely on the purposes for which the glue is intended. The joinery trade is particularly interested in strength and spread, the gummed paper manufacturer in tackiness and foam, etc. It will be seen therefore that it is not necessary for any one particular trade to utilise all the tests laid down. Apart from the industry itself, these methods of test should prove particularly interesting to all those concerned with the examination of glues, both in the laboratory and in the workshop. Copies of this British standard (B.S. No. 647–1935) may be obtained from the Publications Department, British Standards Institution, 28 Victoria Street, London, S.W.1, price 3*s*. 8*d*., including postage.

Maximum Error of Observations

THE statistical properties of the mean of a set of N observations are well known. E. J. Gumbel (*Ann. l'Institut Henri Poincaré*, 5, 115; 1935) discusses the properties of the greatest and least observations of a set, a problem of importance when it is desired to estimate the maximum error of observations. If the distribution of the original observations is normal, or, more generally, what is called of exponential type, the distribution of the extreme values is doubly exponential. Similar conclusions hold for the second greatest and second least, and so on. The work is related to that of Prof. R. A. Fisher, but treated from a different point of view. M. Gumbel remarks that the theory has been applied to the determination of the greatest deviation of artillery fire, the intervals between radioactive emissions, the extreme duration of human life and the intelligence of a racial minority in a certain country of central Europe.

Mechanism of Salt Absorption by Plant Cells

By Dr. W. J. V. Osterhout, Rockefeller Institute for Medical Research, New York

TO solve the problem of the mechanism of the absorption of electrolytes by the plant cell, we need accurate knowledge of what goes on inside the cell. This cannot be obtained with cells of ordinary size. We have therefore studied very large multinucleate plant cells, especially those of *Valonia*[1]. Since this work has called forth comments[2], due to misunderstanding, a brief statement of facts is submitted, although this statement is naturally far from being complete.

(1) *Injury*. A great advantage of *Valonia* is the ease with which injury can be detected. In our laboratory especial care has always been used to avoid working on injured cells. Dr. Steward concludes that our experiments with ammonium chloride were made with injured cells. Working at the high temperatures of Tortugas in the summer, he found that *Valonia* was easily injured by ammonium chloride.

This may happen also in Bermuda in summer, but in winter cells are obtainable which benefit by concentrations of ammonium chloride up to 0·005 *M*. They behave as plants usually do when given an optimum amount of nitrogen. In such experiments certain precautions are necessary, as we have gradually learned during several years of work. The proper handling of these cells requires considerable experience. When the internal concentration of NH_4^+ approaches 0·3 *M* injury may result. This was not the case here.

The following evidences of injury are cited by Dr. Steward:

(*a*) Sodium entered more rapidly than in the controls. This is not significant in view of the fact that in other experiments the rate of entrance in the controls was very variable and was sometimes greater than in this case.

(*b*) Potassium went out 'with the gradient'. It may be misleading to speak of the passage of a cation 'with' or 'against' a gradient without considering the accompanying anion and the product of the ions, which is proportional to the chemical potential. To call this injury is to misunderstand the situation. For injury always causes an escape of potassium chloride which, though much more concentrated inside the cell than outside, is normally retained because the protoplasm is only slightly permeable to it. Injury quickly increases the permeability, and in consequence potassium chloride comes out and growth ceases.

Our experiments present a picture in no way resembling this. No chloride escaped. On the contrary, it continued to enter as usual 'against a gradient', a conclusive proof that the cell was not injured. (During this period the gain in moles of chloride was 14·1 per cent; the loss of potassium was about 15·8 per cent. Presumably potassium went out as potassium hydroxide, to which the protoplasm is normally very permeable.) At the same time ammonium entered ('against a gradient') and became more than a hundred times as concentrated inside as outside. This could not happen if the cell were injured.

Moreover, the cells were better than the controls in growth, in photosynthesis (unpublished work) and in general appearance. They lived indefinitely. In experiments lasting a month a few cells died, but the death rate was no higher than in the controls. The expression "corrected volume" applied to these cells has nothing to do with the death of cells. (All volumes were multiplied by the same factor.)

(*c*) A misunderstanding must be responsible for the following statement. "Considerable prominence has been given to the fact that an external *p*H of 5·5 which causes irreversible injury and death also produces loss of potassium ions." In our work the lowest external *p*H was 6·8, at which there was no sign of injury. According to Steward, 7 is optimal for absorption.

(2) *Metabolism*. Dr. Steward concludes that the study of *Valonia* must be misleading because its metabolism is less than that of storage tissues (for example, potato) the chemical activity of which has been abnormally raised by being cut into thin slices and placed in well-aerated solutions. (Cutting increases abnormally the output of carbon dioxide.)

This involves the relation of metabolism to the absorption of electrolytes. In *Valonia*, the production of carbon dioxide (and of other organic acids) keeps the chemical potential of potassium hydroxide less inside than outside: hence potassium hydroxide continues to enter. The metabolism of *Valonia* is ample for this purpose. The *p*H of the sap is about 5·8 as compared with 8·0 to 8·2 of the sea-water. In a cell 1 cm. in diameter the volume of the protoplasm is less than one per cent of the total. Hence a correct estimate of metabolism, based on the amount of protoplasm, will be more than a hundred times as great as one based on the volume of the cell. In the laboratory the growth in volume under favourable conditions is 0·5–2 per cent per day.

Other aspects of metabolism may be important: if so, it should eventually be possible to demonstrate their roles as clearly as that of carbon dioxide in *Valonia* (and in models).

(3) *Theoretical*. (*a*) When we increase the external *p*H, potassium goes in more rapidly. Its entrance decreases the activity of water inside and raises the osmotic pressure, so that water enters more rapidly: in consequence, the internal concentration of potassium remains approximately constant. Hence the only way to find out how fast potassium enters is to measure the increase of moles of potassium in the cell.

(*b*) If potassium enters chiefly as potassium hydroxide, its rate of entrance will increase with increasing *p*H until secondary changes begin to interfere. Such secondary changes become striking at high *p*H values and undoubtedly begin much lower. It is therefore impossible on theoretical grounds to predict the optimum *p*H. If it should turn out to be 7 in any given case, it would not invalidate the hypothesis.

(*c*) Since *Valonia* is able to accumulate electrolytes without the complications of storage tissues —for example, the presence of intercellular spaces and of injured or altered cells in the sliced tissues, the fact that the cells are placed under abnormal

conditions, and the impossibility of obtaining the cell sap without contamination and chemical change—we must perforce congratulate ourselves on finding such a satisfactory organism for study.

Certain principles which appear to govern accumulation in *Valonia* are so simple that they have been embodied in models in which potassium chloride enters until its chemical potential inside becomes several times as great as outside. (This depends on the bubbling of carbon dioxide through the artificial sap to imitate its production by the living cell.) Such increase in chemical potential involves an expenditure of energy, which comes from chemical reactions (as it does in the cell).

Some of these principles play an important role in other organisms. Future research must reveal the extent of their application.

[1] Osterhout, W. J. V., *Ergebnisse der Physiol.*, 35, 967; 1935.
[2] Steward, F. C., NATURE, 135, 553; 1935.

By Dr. F. C. Steward, Birkbeck College, University of London

ONLY minor comments are necessary to the reply of Dr. Osterhout, which is devoted mainly to the question of injury to *V. macrophysa* by ammonium chloride.

Even if the ammonia experiments are free from the suspicion of injury, the fact still remains that the subsequent movements of *potassium* and *sodium* neither necessitate a distinction between ions and molecules nor are they in the direction usually associated with accumulation.

In order to evade the unfortunate implications of the results with respect to sodium, Dr. Osterhout implies that a difference between the 'control' and 'ammonia' groups which, on the data given, is clearly significant, is after all not real. This difference, whether due to injury or not, is certainly in a direction not in accord with the theory and cannot be dismissed, because of the behaviour of cells (unpublished) which were not strict controls for this experiment[1].

Since injury "in the summer time", even at Bermuda, to *V. macrophysa* by ammonium chloride is now acknowledged, readers will scrutinise even more carefully any crucial experiments which involve this salt, and, no doubt, demand more precise designation than the vague terms 'summer' and 'winter', of the seasonal variations which can be tolerated and the limits of internal concentration which differentiate an 'injurious' from a 'beneficial' effect (it is stated[2] that injury occurs in the Bermuda material at a concentration "less than 0·3M".)

However, the major problem is not the applicability of the theory to the absorption of ammonia, or even its ability to explain the secondary effects which this substance produces on the distribution of potassium and sodium, but rather its generalisation to embrace the initial accumulation of all electrolytes, even the alkali halides.

To the discussion of the effects of external reaction, in so far as they test the theory, Dr. Osterhout contributes two observations although he does not answer the more searching criticisms. One denies that the theory derived any of its support from its undoubted ability to explain qualitatively the behaviour of cells in a medium equally acid as the sap, and the second insists that vague, unspecified "secondary" effects obscure the direct effects of external hydroxyl ion concentration which the theory demands. A theory which, already heavily weighted with hypothesis, fails to satisfy a direct test and can only be retained by resort to such vague assumptions would be better abandoned.

Clearly, one cannot conclude from the work on *Valonia* that the simple mechanism suggested will explain adequately the general facts of salt accumulation by cells[3]. Dr. Osterhout may dismiss the metabolic processes which accompany rapid salt accumulation in storage tissue by regarding them as abnormal chemical activity; but if so, he must also be prepared to eliminate as "abnormal" some of the most fundamental attributes of actively growing cells which, in roots and developing leaves (aquatic and otherwise), are now known to be as intimately concerned with salt accumulation as in the cut storage tissues. The theory of "thermodynamic potentials of free base" and its subsidiary hypotheses is completely inadequate as an explanation of the behaviour of any or all of these systems.

If this discussion emphasises that the problem is still an open one, it may not have been in vain.

[1] A. G. Jacques and W. J. V. Osterhout, *J. Gen. Phys.*, 14, 309; 1930.
[2] W. C. Cooper and W. J. V. Osterhout, *J. Gen. Phys.*, 14, 124; 1930.
[3] F. C. Steward, *Ann. Rev. Biochem.*, 4, 527; 1935.

Progress of Building Research*

THE work of the Building Research Board embraces the products of such a wide range of industries and touches so closely upon the lives of the people that any description of its work is not only of scientific value but is also of importance to the industries directly and indirectly concerned, while at the same time the record is a serious contribution to the material side of social improvement. In this last connexion, it is interesting to note in the annual report for 1934, recently issued, that the Board's resources for research and inquiry have been placed at the disposal of a departmental committee appointed by the Ministry of Health to report on materials and methods of construction suitable for working-class flats.

In the search for fire-proof materials, officers of the Building Research Station have worked in close co-operation with the Fire Offices Committee in the design of the laboratory for fire resistance tests at Elstree (NATURE, Dec. 21, p. 996). The need for data on the transmission of sound through the fabric of a building has led to the provision at the Research Station, in conjunction with the National Physical Laboratory, of facilities for full-scale tests on floors and to the setting up of a special Sub-Committee on Sound Transmission. The problem of impact noises

*Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the Year 1934. Pp. x+174+14 plates. (London: H.M. Stationery Office, 1935.) 3s. 6d. net.

—the cause of considerable anxiety in certain types of construction—is also under examination.

On the subject of damage to buildings by vibration from traffic, machinery, pile-driving and other sources, the investigations, started some years ago and discontinued, are now being resumed, and a preliminary programme of research has been outlined. While it would appear from the report that vibration stresses are, in general, below the estimated fatigue strength of brickwork and concrete even after allowing for considerable stress amplification due to resonance, they are, however, above the compressive fatigue strength of lime mortar, which is therefore liable to gradual disintegration. For the more thorough investigation of this most complex question, special vibrators are being designed for use both on the structures and on the ground, and dynamic extensometers are to be used in the measurement of strains.

The determination of Young's modulus for various building materials, including stone, brick, concrete tiles and asbestos sheeting, has been effected by measuring the frequency of vibration of a specimen in a special apparatus which is described. The error in the observed value of the frequency can be limited to $\pm 0 \cdot 5$ per cent, and the modulus is derived from the formula $E = 4l^2n^2\rho$.

Wind-pressure measurements made on the Severn Bridge during a gale in January are discussed, and further tests on the shielding effect of one building on another have yielded certain general conclusions. To carry this investigation further, a model of a portion of London is being made for tests in a wind tunnel.

The general research work of the Station has included the important problem of the weathering qualities of natural building stones, and the report claims that by applying simple tests the value of Portland stone samples can now be determined with confidence. Certain common terms in specifications are held to be needlessly restrictive of choice and tend to exclude material of the best weathering quality. The information available points to the prime importance of careful selection of the stone, and suggests considerable doubt as to the value of preservatives. The effects of atmospheric pollution and of various physical factors influencing weathering are also discussed, and a lengthy investigation on the relation of micro-organisms to the decay of stone is stated to have shown that these are not directly responsible in any considerable degree for the processes of decay—nor, as yet, have they been found to exert any indirect influence. Many other building materials have been under review, and the notes on these give valuable information as to their properties.

It is, however, with structures and the strength of materials that the major part of the report deals, and in this section the results of the investigations are set out in detail. Concrete beams, piles and road slabs have been the subjects of large-scale experiments, and in the case of beams comparative tests were made for the Ministry of Transport to ascertain the behaviour under load of ordinary reinforced concrete, of Ritchie type and of modified Ritchie type continuous girders. Photographs, diagrams and tables give a clear picture of the results obtained, and these show that the ultimate loads carried by the Ritchie and modified Ritchie beams are about 15 per cent higher than those carried by the ordinary type. If, however, the point of failure be taken as that at which the rate of increase of deflection with load begins to become excessive, the conclusion is that there is little to choose between the three types, which each carry, at this point, about three times the working load.

From these brief notes of the subject matter of the report, it will be gathered that this is a volume which should receive close attention from those who are engaged in research in this or cognate fields, or associated professionally or industrially with modern problems of building. J. A. C.

Increasing Aridity in West Africa

BEFORE Section E (Geography) of the British Association meeting at Norwich, Prof. E. P. Stebbing returned to the subject of "The Encroaching Sahara", on which he read a very important paper to the Royal Geographical Society in March of this year (see *Geog. J.*, 85, 506, June 1935). Leaving on one side the difficult and still disputed question of secular desiccation, it is clear that the activities of man have resulted in assisting the spread of desert and semi-desert conditions—"the eastern Sahara Desert is advancing south and threatening the future prosperity of considerable stretches of West Africa".

As a forester, Prof. Stebbing naturally attributes this to the removal of forest, but it would be nearer the truth to say that the removal of any natural vegetation cover, whether by man-made fire and the plough or through grazing by man's domestic animals, conduces to soil erosion and so to deterioration and apparent desiccation. This has happened in the middle western States of America through the ploughing of prairie grassland, and is now being actively combatted; it is happening in West Africa through the shifting cultivation and increasing herds of a semi-civilised population, and is not yet being arrested.

Prof. Stebbing's suggestion for West Africa is to preserve against human occupation and grazing two continuous east to west belts of forest—one, with a minimum width of 7½ miles, of dry forest in the latitude of Lake Chad; the other a belt 30–50 miles wide in the moister savannah forests farther south. It is not a question of planting forest belts as has been suggested for the United States, but is one of preserving strips of the natural vegetation.

Such a suggestion seems simple, but it is directly opposed to British Government policy in West Africa. The laudable aim of the British has been to interfere as little as possible with the habits of the people, and so shifting cultivation and indiscriminate grazing are permissible. Indeed, under the peaceful conditions of the British regime the people, their herds and flocks have all multiplied, and the evil has been intensified at an ever-increasing pace. It is essential that the state of affairs should be widely known amongst those concerned with education in West Africa—part of the remedy lies in their hands. L. D. S.

Recent Aeronautical Research

THE annual report for 1934–35 of the Aeronautical Research Committee* summarises the progress made in the investigation of scientific questions and the dissemination of the knowledge made available during that period. The report takes the usual form of a general survey of the whole field with fourteen detailed supplements upon various divisions.

The outstanding technical achievement of the year is considered to be the designing of the *D H* Comet, which flew and won the race from Mildenhall to Melbourne, a distance of 11,300 miles, in less than three days. This performance was not due to any particular discovery made during that year, but simply to having put into practice principles that scientific research has gradually established over a period of many years. Among these are the necessity for clean design, avoidance of mutual interference of parts, use of variable pitched airscrews and retractable undercarriages, the application of reduced speed landing devices, engine-cooling with minimum drag, etc.

The report visualises further possible increases in aircraft performance due to the steadily maintained improvement in aero-engines, progress in engine cooling, fuller appreciation of the aerodynamic causes and effects of skin friction and the development of lighter methods of construction. When this increased efficiency is directed towards higher speeds, the possibilities of flutter of certain parts developing is increased, and it is suggested that a criterion for stiffness to limit this must rank of equal importance with that for structural strength. Also, high speeds necessitate the use of speed-reducing devices, such as flaps and slots, for landing, and while these are successfully used in an empirical manner, a more detailed knowledge of the flow of air over wings at slow speeds is needed before their behaviour can be understood and forecast.

Investigations into the meteorological conditions affecting aircraft, particularly the measurements of accelerations in gusts, have confirmed that, for average flying speeds of to-day, an additional loading equivalent to not more than twice the aircraft weight is the maximum likely to be met. Design strength regulations at present in use cover these cases sufficiently. Work is continuing on the design of instruments to be attached to high masts in order that a more comprehensive investigation into the velocity gradients extant upon the borders of large atmospheric disturbances can be completed.

The introduction of new research apparatus at the Royal Aircraft Establishment and the National Physical Laboratory appears to have resulted in a notable, although perhaps indirect, advance in knowledge. The explaining of certain apparent phenomena has led to a fuller investigation of the physical conditions of the experiments, which is reflected in the better co-ordination of the experimental results with actual practice.

Progress in certain directions has been made with regard to silencing of aircraft. Well-silenced engine exhausts, and the use of slow-running airscrews, has now reduced those sources of noise to an amount less than that due to the motion of the machine through the air. Thus the principal remaining cause of noise, air disturbances, will probably be reduced in time, as the efforts of designers towards aerodynamical efficiency result in machines that set up less disturbance in flight.

Investigations into the possibilities of large aircraft for civil aviation have led the Committee to the conclusion that there is no inherent difficulty in the construction of machines up to weights of two hundred tons. The flying boat or seaplane with six or eight engines appears to offer the most promising lines of development. Practical difficulties in the installation of such a large engine-power are to be expected, and the aerodynamic efficiency of a number of airscrews distributed along the wings will need investigation.

The most outstanding work in the engine section is that of reducing fuel consumption in flight by the perfection of an automatic mixture control functioning with altitude changes. Trials of this over extended periods have shown reductions up to thirty per cent in consumption. Apart from actual monetary saving, this will give greater air endurance for a given tankage, and relieve the pilot from the necessity of adjusting this control constantly, as is now necessary.

It has been discovered that ice formation in the carburettor can be prevented by the addition of alcohol to the petrol. A device has been produced for detecting automatically the need for, and supplying the necessary proportion of alcohol. There has been progress with compression-ignition engines, particularly with one of sleeve valve form, but as contemporary progress in the petrol engine more than keeps pace with this, there appears to be no immediate prospect of the adoption of this type, when the most important consideration is efficiency.

The supplements to the report deal with these and many other problems in greater detail.

The work of the Committee during the past year, as summarised in this report, has leaned towards consolidation and elaboration of detail, rather than anything leading towards new lines of thought.

* Aeronautical Research Committee. Report for the Year 1934–35. Pp. iv+74+4 plates. (London. H.M. Stationery Office, 1935.) 1*s*. 6*d*. net.

Mathematical Sciences in France a Century Ago

AT the annual public meeting of the Paris Academy of Sciences held on December 28, 1835, the president, Baron Charles Dupin, delivered a discourse on "Some Advance which the Mathematical Sciences have made in France since the Year 1830". A translation of this afterwards appeared in the *Magazine of Popular Science*, vol. 2, from which the following notes and extracts have been taken:

Commencing with references to the work of Fourier and Legendre, who had died in 1830 and 1833 respectively, Baron Dupin went on to speak of the researches of Poisson, of Poinsot, "the creator of the theory of couples which has so changed the face of statics and dynamics", of the young geometers Coriolis, Duhamel, Liouville and Sturm; of Prony, Poncelet and Morin, and also of the work of Pontecoulant and other French astronomers.

Turning to "those noble undertakings which are destined to describe mathematically the coasts, the territory and the soil of France", Dupin said: "After having undertaken and completed under the Empire, the hydrography of the coasts of Belgium, and of Holland, and next that of the shores of the ocean from Ushant to Spain, M. Beautemps-Beaupré, our colleague, is now continuing, on the same plan, the

hydrography of the shores of the Channel, and which will be followed by that of the Mediterranean. . . . A word will be sufficient to enable us to appreciate the magnitude of the undertaking. Two hundred thousand pounds, thirty years labour of the hydrographical corps, one half the life of its chief, and four hundred and fifty quarto volumes of observations and calculations, have been necessary to accomplish the hydrographical surveys of the coasts of France, to complete them in their two-fold relation to commerce and the naval interests, and to adapt them to the preparation of the grand atlas of the 'Pilote Français' ".

"The application of the mathematical sciences to those which are designated the natural ones—to the wants of the productive arts—to public works, of which we have presented such fine examples from works over which the Academy presides, forms the most remarkable characteristic in the actual progress of human knowledge. . . . The theory of heat promulgated by Fourier still excites attention. It has been made the subject of a large work by M. Poisson. . . . Effects which the reduction of heat by chemical means cannot produce are now accomplished by mechanical agency. In 1830 the Academy rewarded the gas compressing machine of M. Thilorier. A corresponding member of the Academy, M. Melloni, has communicated to us new facts relating to radiant heat."

From the midst of those philosophers devoted to electricity, "M. Becquerel has opened a path for himself. He has attacked chemistry with weapons of his own preparation, to subdue her to the dominion of mathematical laws. . . . Gifted by nature with extreme delicacy of the organs of sense, and exquisite power of observation, we may justly entitle him the Wollaston of France".

In other branches of investigation, "M. Majendie has borrowed from mechanical laws his explanation of the sounds of the human heart. . . . M. Flourens seeks in the mechanical pressure exercised upon the brain, an explanation of the condition of those persons who undergo the operation of trepanning . . . and M. Dutrochet who has communicated to us so many facts, the fruit of his ingenious observations on the internal dynamics of vegetables, has pushed his investigations into the mechanism of the respiration of insects, both aquatic and aerial".

In concluding his discourse, Baron Dupin said: "I am far from having enumerated all the recent modes in which mathematics have been applied to natural science. I have not even hinted at its application to that of politics, and of social economy, nor to the subject of population. Having individually taken a part in these discussions I shall pass them unnoticed".

"But in this sketch rapid, incomplete, imperfect, I ask with confidence, Do you not recognise the ever-increasing utility of science, the extent of her benefits, the sublimity of her titles, even during the short, embarrassed and turbulent period to which I have confined myself? The sciences must have therefore of necessity, a vital energy peculiar to themselves; a progressive power, superior to the obstacles of time, of things, and of man. Human passions, vulgar ambitions, and party-interests, pass away, but the labours of science, the sacrifices made for her sake, the victories borne off in her name, remain, and contribute to the enlargement of that splendid and profitable heritage on which, at the present day, is based her real grandeur."

Societies and Academies

PARIS

Academy of Sciences, November 25 (*C.R.*, 201, 997–1072). LUCIEN DANIEL: An accidental crossing of the bean. A detailed account of a hybrid bean, the descendants of which do not appear to be in agreement with the Mendel scheme. DIMITRI RIABOUCHINSKY was elected *Correspondant* for the Section of Mechanics in the place of the late M. de Sparre. NICOLAS KRYLOFF and NICOLAS BOGOLIOUBOFF: Some theorems of the general theory of measure. PAUL VINCENSINI: The curvature of congruences of spheres. ENRICO BOMPIANI: A system of curves of a surface invariant by projectivities. D. VAN DANTZIG: The idea of the derivative of a functional. DAVID WOLKOWITSCH: The theoretical problem of balancing rotating parts. ALFRED ROSENBLATT: Certain classes of movements symmetrical with respect to an axis of an incompressible viscous liquid. ANDRÉ AURIC: A cosmogonic hypothesis. CHARLES VALLOT: A new map of the Mont Blanc massif by Henri, Joseph and Charles Vallot on the scale of 1 : 20,000. PIERRE MARTI: A gravimetric cruise of the submarine *Fresnel* in the north-west part of the Mediterranean basin in 1933–34. Work done with the Vening-Meinesz apparatus for the determination of g at sea on the coasts of France, Spain, Corsica and the Balearic Islands. An outline of the results, with a chart, is given: a full account of the results will be published elsewhere. REZA RADMANECHE: The action of the ultra-violet rays on the electrical conductivity of quartz. The experimental results are summarised in a diagram. MAURICE LAMBREY: A system of transformation with logarithmic argument for continuous current. JEAN LAGRULA: An error in photographic photometry. Discussion of the effect of the inequality of the surfaces of the photographic plates and means of avoiding the errors thus produced. LOUIS D'OR: The absorption spectra of sulphur vapour. The author concludes from his experiments that sulphur vapour contains at least four species of molecules, excluding S_1. The spectrum described by Graham, Dobbie and Fox, and by Rosen is not due to S_8 (Graham) or S_2 (Rosen) but to an intermediate molecule, probably S_4. JEAN TERRIEN: The rotation structure of the D and E systems of bands of cuprous chloride. MICHEL KANTZER: The influence of pressure and of foreign gases on the optical absorption of chromyl chloride. A. VILA and F. TESSON: The measurement of the mechanical properties of plastic films. JACQUES BANCELIN and YVES CRIMAIL: Substances inhibiting the corrosion of iron by acids. A comparison of the effects produced by the addition of rhodamine and of thiourea to the acid solution showed that whilst the anti-corrosion effect of rhodamine increased with the concentration, there was a certain concentration of thiourea for which the corrosion of the iron was a minimum. O. BINDER: The decomposition of pentahydrated copper sulphate by heat. Crystallised copper sulphate heated to 650° C. gives a basic sulphate $2CuO.SO_3$, proved by chemical analysis and by a study of the X-ray spectrum to be a definite compound. EMILE CARRIÈRE and MLLE. LUCY FAYSSE: The comparative action on sodium thiosulphate of oxygen compounds of chlorine and of the corresponding oxygen compounds of iodine. JOSEPH MAGROU: Attempts at the culture of mycorrhizal fungi. ANTOINE DE CUGNAC: Remarks